Ontario. Hydro-Electric Power Comm
Hydro news

The BULLETIN

POWER FOR MUNICIPAL UTILITIES

POWER FOR HOUSEHOLD CONVENIENCES

Hydro-Electric Power Commission of Ontario

Volume XXIII — JANUARY - DECEMBER, 1936 — Number 1- 12

Vol. 23-24

POWER FOR INDUSTRY

LIGHT FOR THE HOME

His Majesty King George VI and Queen Elizabeth

HYDRO IS YOURS - *USE IT* !

Municipal Loads and Interim Bills

November, 1936

NIAGARA SYSTEM

	H.P.	Dollars
Acton	990	2,435
Agincourt	153	477
Ailsa Craig	106	430
Alvinston	86	522
Amherstburg	704	2,084
Ancaster Twp.	289	711
Arkona	51	293
Aurora	1,122	2,384
Aylmer	574	1,554
Ayr	197	517
Baden	345	876
Beachville	413	1,049
Belle River	138	431
Blenheim	406	1,235
Blyth	112	481
Bolton	128	431
Bothwell	123	457
Brampton	2,352	5,684
Brantford	15,623	31,943
Brantford Twp.	655	1,610
Bridgeport	111	310
Brigden	65	340
Bronte	Kw-hr.	410
Brussels	137	541
Burford	156	423
Burgessville	33	147
Caledonia	310	763
Campbellville	31	150
Cayuga	110	417
Chatham	5,847	13,887
Chippawa	269	527
Clifford	68	303
Clinton	419	1,241
Comber	130	471
Cottam	73	257
Courtright	37	208
Dashwood	82	326
Delaware	43	138
Dorchester	91	301
Drayton	94	418
Dresden	315	1,091
Drumbo	68	218
Dublin	35	168
Dundas	1,777	3,628
Dunnville	1,041	2,559
Dutton	239	707
Elmira	603	1,684
Elora	306	856
Embro	91	336
Erieau	67	288
Erie Beach	7	39
Essex	425	1,186
Etobicoke Twp.	4,844	10,293
Exeter	399	1,212
Fergus	1,007	2,810
Fonthill	135	355
Forest	352	1,275
Galt	6,593	13,461
Georgetown	1,167	3,257
Glencoe	191	852
Goderich	1,051	3,548
Granton	65	272
Guelph	9,468	20,120
Hagersville	749	1,903
Hamilton	99,848	183,055
Harriston	323	1,092
Harrow	366	1,113
Hensall	171	678
Hespeler	1,884	4,160
Highgate	61	225
Humberstone	429	948
Ingersoll	2,229	4,923
Jarvis	198	618
Kingsville	515	1,566
Kitchener	18,068	36,888
Lambeth	117	386
La Salle	186	534
Leamington	1,361	4,025
Listowel	915	2,631
London	34,331	70,092
London Twp.	502	1,317
Long Branch	855	1,960
Lucan	134	396
Lynden	86	255
Markham	308	886
Merlin	64	233
Merritton	4,773	8,551
Milton	733	1,984
Milverton	320	894
Mimico	2,472	4,841
Mitchell	427	1,120
Moorefield	48	250
Mount Brydges	104	344
Newbury	51	218
New Hamburg	441	1,196
Newmarket	1,535	3,262
New Toronto	6,244	14,309
Niagara Falls	9,623	15,237
Niagara-on-the-Lake	441	900
Norwich	379	1,026
Oakville	Kw-hr.	2,916
Oil Springs	206	712
Otterville	113	402
Palmerston	415	1,297
Paris	1,281	2,721
Parkhill	146	700
Petrolia	1,002	3,178
Plattsville	62	244
Point Edward	996	2,946
Port Colborne	1,670	3,689
Port Credit	771	2,023
Port Dalhousie	574	1,317
Port Dover	356	1,054
Port Rowan	62	273
Port Stanley	209	635
Preston	2,739	5,591
Princeton	106	375
Queenston	98	216
Richmond Hill	378	1,024
Ridgetown	468	1,384
Riverside	1,000	2,626
Rockwood	103	322
Rodney	170	665
St. Catharines	11,135	19,022
St. Clair Beach	71	221
St. George	156	489
St. Jacobs	271	712
St. Marys	1,232	3,440
St. Thomas	7,304	15,521
Sarnia	8,354	21,234
Scarboro Twp.	3,422	8,413
Seaforth	513	1,391
Simcoe	1,952	4,473
Smithville	Kw.-hr.	415
Springfield	66	250
Stamford Twp.	2,121	3,711
Stouffville	225	799
Stratford	6,481	14,852
Strathroy	1,072	2,815

THE
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Hydro at the End of 1935

By T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario

THE business of the Hydro-Electric Power Commission during 1935 indicates a steady recovery in industry and commerce, but at a slower pace than in 1934. Two conspicuous increases in the industrial load stand out above all others.

The Commission has been able to aid materially in the development of gold mining in Northwestern Ontario, by making contracts with companies which find their properties workable at the present price of gold and of power. Some of these properties would have been able to work their marginal ores on the new price of gold, even if power rates had continued at the former level, which was, speaking generally, $50 per horsepower per year on contracts for the life of the mine. The majority of them, however, require both the present price of gold and of power, the standard of which is now $32.50 per horsepower per year, to make their operations profitable.

If the output in Northwestern Ontario increases to $100,000,000 or more per year during the next three or four years, a very considerable share of the credit for this increased output must be given to the operating conditions which have enabled the Hydro to cut the cost of power throughout the area supplied from the Abitibi Canyon Development.

The increase in the gold-mining loads has enabled the Commission to meet all expenditures incurred in the operation of the Northern Power Properties, which are the properties of the people of Ontario and not of the Hydro municipalities, and to provide for the payment of interest and maintenance costs. The margin of profit does not [illegible] provide for sinking fund, but it is hoped that during the year upon which we have entered the increase of revenue will be sufficient to provide for the sinking fund charges. Should that hope be realized the great boon of cheap power, for the operation of mines working upon marginal ores, will have become available to the mine owners without cost to the taxpayers of Ontario.

The supply of power in the North has been greatly increased during the

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JANUARY, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

year by the bringing into operation of Units Nos. 3 and 4 at the Abitibi Canyon. This doubling of the available quantity of power has enabled the Commission to make a contract with the International Nickel Company for the most important heat load yet entered into by the Commission. A development of the most far-reaching character in the use of electric energy for the melting of copper in electric furnaces has been undertaken by the company at its Sudbury plant, and it has closed a contract with the Commission, under which within a short time it is expected at least 8,000 to 10,000 horsepower will be utilized for the melting of copper mined at Sudbury, and its reduction to marketable form. Mr. Donald MacAskill, General Manager of the company, negotiated the contract, which will be the largest metallurgical heat load added to the Commission's contracts for energy up to the present time.

The expansion of the Hydro-Electric Power Commission's service in the industrial field is largely at the moment in the direction of heat loads. During the past year an important installation was made of an electric furnace by the Burlington Steel Company at Hamilton. The ingots turned out by the direct application of electric heat in this furnace are said to be of much more uniform high quality than similar metal produced by other processes, and the Commission looks forward to a very general increase in the melting of metals by direct application of electric heat.

These loads will take the place of the sale of energy for the production of steam under steam electric boilers by paper mills and other industrial establishments, in which large quantities of steam are used in processing. Because of the great surplus of otherwise unsaleable power, provided under the Quebec contracts, now cancelled, the Commission during the past four years has been supplying energy in very large quantities for these steam boiler loads. Last year about one-fifth of all the kilowatt-hours sold by the Commission were used to produce steam, largely for paper mills and similar industries.

How unprofitable this use of electric energy was, can perhaps best be shown by the following statement:

In the City of Toronto, during the year ending December the 31st, 1934, the consumption for which the Civic Commission paid the Hydro-Electric Power Commission was on a maximum volume of 301,114 h.p. The

Toronto Commission paid to the Provincial Commission for this power, measured on a peak load, $6,676,000. In turn it sold to the consumers of the City of Toronto 880,618,000 kilowatt-hours of energy, for which it received $12,260,163.

During the same year, a Provincial Commission's consumer in the Niagara District purchased for steam production purposes 424,315,000 kilowatt-hours, for which the Commission received only $212,157. This one industrial establishment, in the production of steam alone, consumed almost half as many kilowatt-hours during 1934 as all the consumers in the City of Toronto. This power was used in competition with coal for the production of steam, and so cheaply was it sold that the Commission derived a revenue of only $212,157 for almost half the number of kilowatt-hours sold by the Toronto Electric Commission (retail) for which Toronto obtained $12,260,000.

The Commission has less than a dozen customers taking electric energy for the production of heat under steam electric boilers. These few customers used, in 1934, more than a fifth of all the number of kilowatt-hours generated and purchased by the Commission in all its systems. The heat load utilized in the production of steam totalled 1,324,411,000 kilowatt-hours. For this the Commission received the sum of $809,386. The energy developed and purchased by the Commission, and supplied to all its customers, before deduction of transmission losses, totalled 6,419,998,000 kilowatt-hours, of which 2,205,077,000 kilowatt-hours was purchased power.

The bulk of this purchased power could not be used profitably in the Commission's ordinary business, and it became necessary, therefore, to dump it at any price that could be obtained for it. Naturally the Commission is not seeking to continue supplying energy for steam electric boilers at the peak of the load. The losses from this business would be ruinous were the energy so supplied to continue across the peak.

At the time of the system peak demand, on one night during November last, the customer in the Niagara District, already referred to, used primary power totalling 32,300 h.p. and steam power totalling 81,800 h.p. This one industry, therefore, consumed on that day more than one-third of the energy required to supply with light, power and heat 700,000 people, who draw their supplies from the Toronto Electric System.

It will be seen from these figures that the steam electric boiler can be used with profit to the Commission only when there is a large surplus of energy not required to supply the firm power customers of the Commission during the winter season's peak loads. There are perhaps, six or seven months of the year when domestic lighting and heat loads do not overlap either in the morning or at night with industrial loads, and the sale of energy for steam power purposes provides a revenue that would be otherwise entirely lost, but even in the general plan for the provision of heat loads by the Commission, as more profitable uses are found for this surplus energy, the steam boiler loads will be reduced, and perhaps ultimately in a large measure eliminated.

The cancellation of the Quebec

power contracts may not only result in the direct saving of somewhat over $500,000 a month to the Commission, but it will very materially reduce the indirect loss sustained through the sale of power for steam boiler purposes at less than $2.25 per horsepower, which during the past four years has been costing the Commission $15 per horsepower at the Quebec border, and at least $4.50 per horsepower for line losses and transmission costs. The householders and factory owners of the Niagara district will no longer be called upon to sell power for $2.25 per horsepower per year that costs them about $20.

The heat loads of the future will, it is hoped, be profitable to the Commission and the Associated Municipalities, instead of a source of very great loss. There has been progress not only in the field of metallurgy, in the application of electric energy but in the allied field of ceramics. A recent installation of electric heating, in substitution of coal fuel, is that for decorating chinaware — 1,600 deg. fahr. Two electric ovens, each of 70 h.p. capacity, were installed to replace a typical conical shaped coal-fired kiln. The electric ovens were arranged for alternative operation on the supply system. That is, while one oven was heating up the other was cooling down. Thus it was possible to operate with a peak load on the electric supply system equivalent to the demand of one oven only.

In addition to considerable saving in time in handling the product, both before and after heating, the following will give an idea of the savings effected:

Electric Ovens—Cost of power, $144 per month. 15,000 dozen pieces; cost per dozen pieces, approximately 1 cent.

Coal-fired Ovens—Cost of fuel, $400 per month. 17,500 dozen pieces; cost per dozen pieces, approximately 2.2 cents.

Thus demonstrating fuel cost is now reduced to one-half of that of previous production. The savings effected will pay for the complete installation in two years.

It is along the line of similar developments, involving improved processes and cost reductions, that the Commission will direct its steps during the coming year. Hitherto the domestic heat loads of the Commission have been greatly in excess of the industrial heating. No less than 520,000 consumers who take energy from the Commission are interested in one form or another of heating appliances. In this great number of homes there are estimated to be in use at the present time:

Electric ranges	130,317
Hotplates	77,001
Grates	33,047
Air heaters	145,312
Flat rate water heaters	30,176
Metered water heaters	33,358
Irons	477,477
Ironers	7,242
Grills	47,015
Toasters	269,417

Of these domestic heat loads, 23,366 are installed in some form in farm houses, where the following appliances are used:

Electric ranges	4,619
Hotplates	5,358
Grates	233
Air heaters	2,695
Flat rate water heaters	680
Metered water heaters	552

Irons	19,230
Ironers	201
Grills	2,005
Toasters	12,648

It will be seen, therefore, that the housewives in more than 500,000 homes in Ontario have become electric-heat minded, and use appliances daily for the production of heat. The total estimated demand in horsepower of these great electric heat loads at the peak hours is 487,000 horsepower. Happily the peak does not occur simultaneously in all the homes. The connected load of these appliances is over 1,731,000 kilowatts, a far greater possible consumption than all the Commission's plants are capable of providing.

The field for expansion in heat loads is very great, and a firm foundation has been laid by the enterprising manufacturers who have pioneered in the application of electric energy to metallurgical processes. There are electric furnaces at present in use in Ontario for the production of:

Carbide and subsequent combining with nitrogen to form fertilizer;

Silicon and ferro chrome for use as alloys with steel;

Steel castings, plain and alloyed, such as manganese steel for resistance to wear, cobalt steels for high speed operations, carbon steels for tool and die work, corrosion and heat resisting steels to offset effects of atmospheric and liquid corrosion where used and in the case of heat resisting to prevent warpage and buckling when used in high temperature locations;

Cast iron castings;

Brass and bronze castings.

There are induction and high frequency furnaces for the melting and refining of copper and nickel alloys as used in the silverware trade and for use in extruding process to obtain rods, mouldings, etc.

There are resistance furnaces for:

Annealing malleable iron castings, steel, copper and brass;

Steel hardening and tempering;

Vitreous enamelling;

Japanning and paint drying;

China decorating and glass annealing;

Carburizing or case hardening;

Galvanizing and sherardizing;

Melting of aluminum;

Melting lead, tin and type metal.

There are heater unit applications, apart from domestic heat uses, for:

Bread baking;

Cereal cooking;

Ranges;

Roasting ovens;

Warming tables;

Grills and hot plates;

Toasters and waffle irons;

Tea and coffee urns;

Water and liquid heaters;

Embossing;

Impregnating;

Air heating.

In connection with electrolytic and electro plating, operations are conducted for:

Decomposition of water into its constituent gasses;

Electro deposition of nickel and copper in process of refining;

Electro plating—gold, silver, nickel, cadmium and copper.

While it is difficult to give definite figures as to the actual amounts of electrical power supplied by the Commission and municipalities in industrial heat applications, the amounts

below quoted are approximately correct:

Electrode furnaces.....	40,000 h.p.
Induction and high frequency furnaces including welding equipment.	7,000 h.p.
Resistance furnaces....	100,000 h.p.
Heater and unit applications................	13,000 h.p.
Electrolytic and electro plating..............	27,000 h.p.
Total industrial........	187,000 h.p.

It will be seen from these figures that already almost one-half of the energy generated and purchased by the Commission is devoted to the production of heat in some beneficial form, either for industry or domestic use. I look forward with hope to the increasing use of electric energy in the gold fields of the Province and its factories.

The Hydro-Electric Power Commission of Ontario and its co-operating municipalities have at risk over $405,000,000 of capital devoted to the production and distribution of electric energy throughout the Province. It is to the interest of the customers of the Commission, who are responsible for the payment of the charges upon this great mass of capital that the business of the Commission shall be carried on as economically as possible, so that a fair return shall be earned on the capital invested in it.

Abitibi Canyon Development.

Manufacture of Concrete Poles by Hamilton Hydro-Electric System

By A. W. Bradt, Chief Engineer, and W. H. Weller, Consulting Engineer

PROPERLY designed and constructed reinforced concrete poles should last indefinitely under normal conditions. This is borne out by the fact that two of the first poles to be put into use in Canada were erected in 1904 to carry a transmission line over the old Welland Canal at St. Catharines, Ont. These poles are one hundred and forty-six feet in length and thirty-three inches square at the base and appear to be in as good condition as the day they were put up. Since that date, thousands of concrete poles have been in satisfactory service in Canada, the United States and Europe. Investigation of cases where poles have failed to stand up has invariably shown that the reason was either poor materials, careless workmanship, faulty design, overloading or a combination of these.

Unfortunately, the poles erected by the Hydro-Electric Commission of the City of Hamilton twenty years ago have not stood the test of time and the concrete has so badly disintegrated that at the present time replacement of the bulk of them is an immediate necessity.

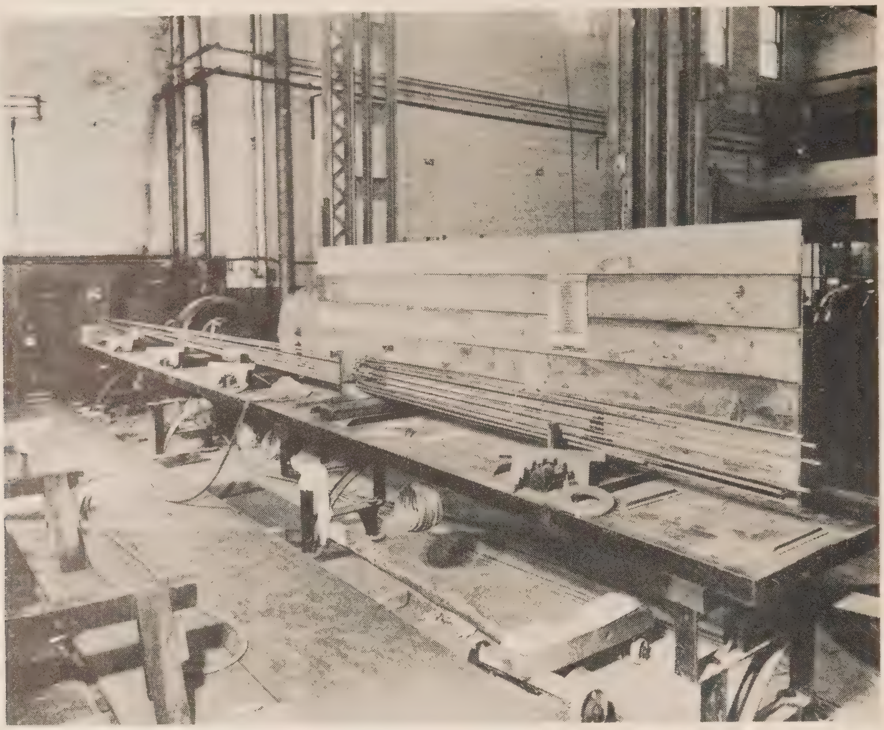
A few years ago an attempt was made to check this disintegration by patching and waterproofing. This work was exceptionally well done and undoubtedly prolonged the life of the poles so treated, but action on the inner concrete had already commenced and it was only a matter of time until expansion caused by this spalled off the outer coating and the destructive action was accelerated by atmospheric conditions.

In addition to the above, the porous nature of this concrete allowed the moisture to reach the steel reinforcing, the corrosion of which forced off the shallow covering of concrete, thus exposing the steel and hastening the corrosive action. This same action took place along the conduit for the street light which projected from the top of the pole.

The Hydro-Electric Commission of the City of Hamilton decided to have its own organization build new poles instead of letting the work out by contract as had been done previously. At the same time, it was decided to have the most up-to-date design of pole, best methods of manufacture and plant layout as well as the best materials available.

A programme was drawn up necessitating the manufacture of ten poles per day the year round and the erection of the same number. This would mean that the defective poles would all be replaced in three years.

Fortunately at this time, May, 1935, a large portion of the substation building on Victoria Ave. was vacant owing to the removal of the last of the old steam plant. This was an ideal location for the plant, especially as being under the same roof as the



Welding fixture with finished cage, showing method of supporting rods while tacking to rings.

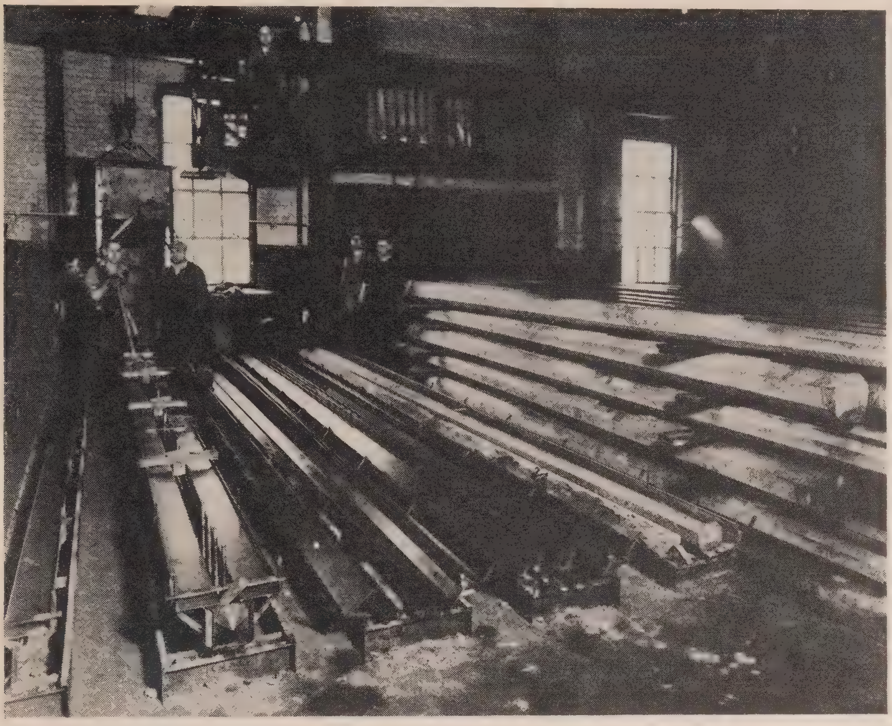
operating part of the building there would be very little added expense for heating during the winter months.

The available space consisted of a main floor, 56 ft. by 75 ft., with a clear span roof. Beneath the heavy concrete and steel floor was a basement having 8 ft. head room. This basement, while partly taken up with machine foundations, still had room to operate a mixer and allow for storage of cement, sand and stone, for which purpose it is now used. In a continuation of this part of the building towards the east is the old original boiler room, the floor of which is at the same elevation as the basement. This building is now used for storing poles.

Plant Layout

The type of mixer used is a 7-S koehring with gasoline engine power loading skip, etc., mounted on wheels. The portable type was used with the idea in mind of using it for general work later on. The water handling equipment on this mixer is of the latest type, allowing easy and accurate measurement. This mixer is set up at the west end of the basement. In the floor above, an opening was made to allow the use of a bucket for transporting the concrete to the forms on the operating floor.

On the operating floor and com mencing immediately above the-mixer, a level casting space was made 40 ft. long by 32 ft. wide by pouring



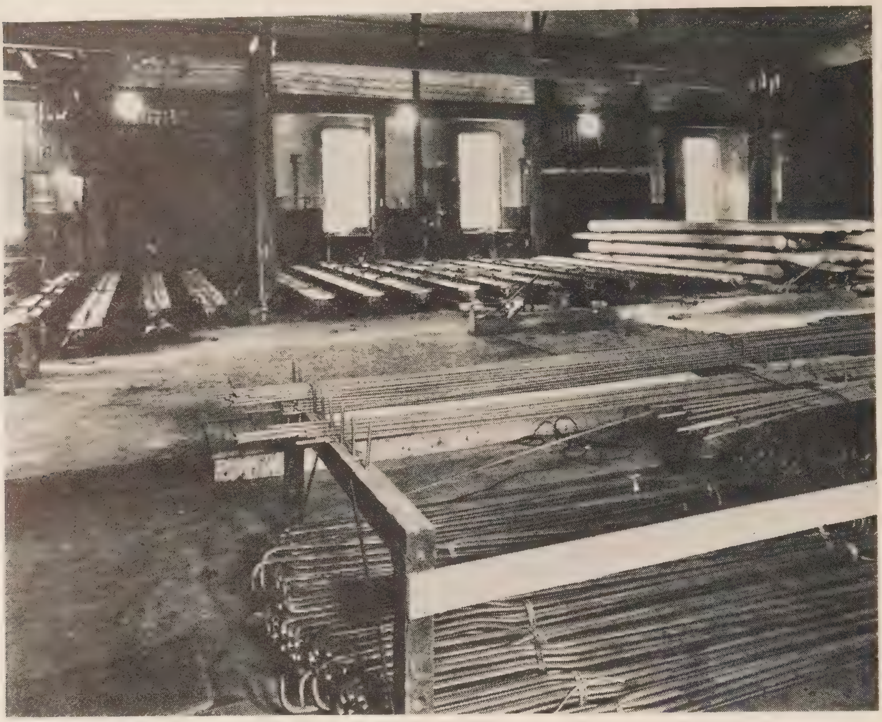
A portion of the operating floor showing some of the forms: form ready for filling, bucket and chute in rear; form open; form open with reinforcing cage; form open with pole poured previous day. In the rear at the top is the electric crane. This picture also shows the complete operating gang used in the manufacture of concrete poles.

a concrete floor over the existing floor and embracing the old foundations which had projected above the original floor. This space was curbed off from the balance of the floor in order to confine any free water. The balance of the floor in continuance of the casting space was now curbed off at the same width, but the floor left at the original elevation or about six inches lower. This space was well drained and is used for curing the poles. The remainder of the floor is used for steel storage, steel cage welding fixture, electric welder, testing poles, etc.

A three-ton Northern Electric crane travels the entire length of the building, including the storage room. This crane handles the concrete from the mixer to the forms by means of a 16 cubic foot bucket having a bottom rotary gate. It also handles the poles when cured and loads poles from storage to trucks.

An electric welder is used for the reinforcing cages which are welded in a fixture designed to hold the rods at the correct spacing.

Concrete is consolidated by the use of a Syntron Vibrator applied by means of a spud through the steel



View of the operating floor showing 15 steel forms, poles curing under spray and reinforcing steel and conduit stock.

cage and against the inside of the form.

STEEL FORMS

Forms are entirely of steel and are of the hinged type. Each side makes three faces of the pole and is made in one piece which is hinged at the bottom to a light channel section base. To this base is rigidly fastened the seventh side. This is machined from boiler plate so that the side forms close against it at the correct angle. The eighth face is open and is finished by trowelling. The sheets forming the sides are bent in the form of a tray to assist in placing concrete. Steel spreaders are used to hold the side forms. The tapered top of the pole is formed by a casting and the butt by a plate. The holes for bracket bolts are made with tapered pins and the conduit is held against the form with short nipples.

The reinforcing cage is held in position by means of a special fixture which also acts as a spreader for holding the side forms.

There are fifteen forms in all, two thirty feet long and thirteen twenty-four feet long.

Sand and stone are dumped from the street level through a chute to the basement behind the mixer, the stone being nearest the loading skip and separated from the sand by a partition. Stone is measured by means of the regular bottomless box placed directly in the skip while the sand,

which is handled by wheelbarrow, is measured by weight, the barrow resting on a platform scale while being loaded. Cement is in paper bags and is stored a short distance from the mixer.

The stone, sand and water for mixing are electrically heated with off-peak power during cold weather.

Curing

The curing space has a capacity of one hundred poles in two piles each of fifty poles, which is one week's run. This space is filled with fine spray from a number of very fine nozzles suitably placed. Each day's run of ten poles is placed in one row and one week's run is kept in the same pile which is not moved to storage till the following week so that no pole gets less than six days curing.

During cold weather, return water from transformers is used for spraying.

Concrete

Strength required: 4,000 lb.

Cement used: Canada Cement XXX.

Sand: Niagara River.

Stone: Dolmite Canada Crushed Stone, ½ in. to ⅜ in.

Mix used at present: 1-2-3- (Moist Sand).

Water: 50 lb. per bag 87½ lb.

Slump: 5½ in. to 6½ in.

Reinforcing

The reinforcing cage for the thirty-foot poles consists of 4 rods 29 ft. 6 in. long, ½ in. diameter, 4 rods 7/16 in. by 24 ft. 6 in., 4 rods 7/16 in. by 17 ft. 9 in., 4 rods 7/16 in. by 12 ft. 9 in. These rods are formed into a cage by electric welding to 6 steel rings ¼ in. diameter.

The effective area of steel at the ground line is 1.14 sq. inches and the weight of the cage is 192.25 lb.

The steel for the 24-ft. poles is the same as for the 30-ft. with 6 ft. cut off the butt and weighs 141.6 lb. All round steel 80,000 lb. untreated.

Design of Poles

Two lengths of poles are being made, 24 ft. and 30 ft. They are octagonal in shape, 6 in. between faces at the top and have a taper of one inch in five feet.

They are designed for a working load of 500 lbs. one foot from the top and the steel is calculated to take care of the bending moment at any section.

A comprehensive stress of 1,000 lb. was used for the concrete and 18,000 lb. for the steel.

A minimum covering of 1¼ in. is allowed for the reinforcing.

There are 4 five-eighth-inch holes through the top end of the poles for bracket bolts and the inlet for the lighting conduit is below the top and in one of the faces instead of in the top as in the old poles.

Tests

Load tests are made at intervals by wedging the butt of the pole to be tested in a reinforced concrete pocket built for the purpose. The weight of the balance of the pole is taken on a dolly placed near the top and allowing the pole to deflect freely. Load is supplied one foot from the top by means of a chain block to which a dynamometer is attached. Deflection readings are taken from a chalk line

Above—Derrick truck erecting a 24 ft. concrete pole. All operations are controlled from the cab.

Right—New concrete poles in a residential district.

stretched over the centre of the pole before loading.

The results to date on thirty-foot poles have shown an average deflection of 4¼ in. for a load of 500 lb. and an ultimate load of 1,600 lb. with a deflection of 21½ in. Five hundred-pound pull one foot from top on the 24-ft. pole gives 7,500 ft. lbs. at ground line and 12,000 ft. lbs. on the 30-ft. The soil will naturally give before this load is reached, therefore, there is little possibility of straining the pole beyond its limit.

Test cylinders, 6 in. by 12 in., are taken during the week, so distributed as to represent an average run of mix. The average results to date, including trial mixes, has averaged

above the 4,000 lb. desired and the concrete, very dense, averaging over 150 lb. per cu. ft.

Operation

The plant crew consists of five men including foreman. Ten forms are filled every morning except Saturday. The afternoon is taken up with finishing the exposed surface of the poles, welding the steel cages, cleaning mixer, etc., and setting up the five extra forms for the next morning. Aggregates, steel, etc., are received in the afternoon whenever possible.

The first operation in the morning is to move the previous day's run of poles to the curing pile and to clean and set up five more forms for the day's run. Saturday being a half day, no poles are made and the previous week's run of poles are placed in storage. Ten sets of forms are set up for the following Monday.

Electricity Marches On

By S. M. Kintner, Vice-President in Charge of Engineering, Westinghouse Electric and Manufacturing Company

THERE are always those who look back on the accomplishments of the past but can't see any hope for a continuance of such improvements for the future. Lord Macauley, more than one hundred years ago, in replying to such an opinion of pessimism, expressed by another important writer of his day, said, "On what principle is it that, when we see nothing but improvement behind us, we are to expect nothing but deterioration before us? To almost all men the state of things under which they have been used to seems to be the necessary state of things. Though in every age everybody sees that up to his own time progressive improvement has been taking place, nobody seems to reckon on any improvement during the next generation. We cannot absolutely prove that those are in error who tell us that society has reached a turning point, that we have seen our best days. But, so said all who came before us and with just as much apparent reason."

It is such thoughts of a completed world that must provoke most of the theories of new social orders. These theories always accompany depressions but fall upon distressed ears when times begin to improve again.

Some say that much of our prosperity resulted from the expansion into new lands and now that all of our home country lands have been used we can no longer expect that kind of prosperity. I can hardly accept that as an answer, while we have so much undeveloped land as now exists in Alaska and the other territories. Neither can I believe that geographic expansion is the only one that counts. How about expansions into the unknown realms of the sciences as a means of producing prosperous conditions? To some that seems so intangible. How do we know there is anything there, and anyhow what more could we hope

to find that would be useful to us? Those are the common questions that face the proponents of such a plan. No one can positively answer them. All we can do is examine the evidence, or as Al. Smith would say, "Let's look at the record".

In the first place we know but little about nature's basic principles. This alone should be encouraging, for if we can accomplish all that we have, with such a poor understanding, isn't it reasonable to expect vastly better results with more knowledge?

It is incredible that anyone should think that our knowledge of nature's laws is anything but exceedingly small when compared to the vast amount that is listed in the unknown column. However, one of our leading universities in the 1894 edition of its year book made the statement that "All of the laws of physics are now known and further developments will consist of more accurate, fourth decimal point determinations of the value of constants." After this followed the discovery of X-rays and electronics, with the important part taken by the latter in radio. Be it said, to the credit of the same university, that it has done some of the best work relating to these newer phases of physics.

People ask "But what more is left to be done? Everything that we really need seems to have already been done." Possibly so, in the light of our present needs.

What Are Our Needs?

Alexander Graham Bell had great trouble interesting capital in exploiting his great invention of the telephone. It was thought to be an interesting scientific device, but of no commercial value. The following quotation from a Boston paper contemporary with Bell's efforts, sixty years ago, shows the public's attitude.

". . . . Joshua Coppersmith, has been arrested in New York for attempting to extort funds from ignorant and superstitious people by exhibiting a device which he says will convey the human voice any distance over metallic wires so that it will be heard by the listener at the other end. He calls the instrument a 'telephone' which is obviously intended to imitate the word 'telegraph' and win the confidence of those who know of the success of the latter instrument without understanding the principles on which it is based.

"Well-informed people know that it is impossible to transmit the human voice over wires as may be done with dots and dashes and signals of the Morse Code, and that, were it possible to do so, the thing would be of no practical value. The authorities who apprehended this criminal are to be congratulated and it is hoped that his punishment will be prompt and fitting, that it may serve as an example to other conscienceless schemers who enrich themselves at the expense of their fellow creatures."

Is it any wonder then that we can't see any great number of needs when our parents had such trouble in seeing the utility of the telephone?

Most of us can recall a world without automobiles, or airplanes, or X-rays, or phonographs, or moving pictures, or radios and it seemed just as complete without these various inventions as it does today with them.

I don't know what form the new inventions will take, but unquestionably many will surpass even those pictured in the imaginative writings of Bellamy and Wells.

In the pure sciences many researches are being made in nearly every important laboratory. Intensive work is under way to learn more of the nature of matter. Man's fondest dream has for ages been to convert one element to another. This dream, to a degree, has now been realized. Many of the elements have been changed to other elements when subjected to bombardment from alpha particles or neutrons. Thus far about half of them have responded to such treatment and there is no reason to doubt that with proper methods of attack most of the others likewise will do so.

The more recent researches have shown radio-activity in many of the materials undergoing change. Thus, some of them have been found to produce radiations with velocities more than twice that of radium. Some of these radio-active substances hold this characteristic for only a brief time while others possess it for weeks.

One naturally thinks of using these radiations instead of X-rays for radiography, or for radium in the treatment of disease. While they will be used to some extent for such purposes, there may be found other uses of even greater importance. No doubt many applications will be made to chemical processes and new compounds will result.

It may afford us a means of producing an efficient source of light instead of the extravagant, even though convenient, incandescent lamps that we use today. I say extravagant because of the low ratio of useful light radiation to the large proportion of heat energy that our present-day lamps give off. Lamps that produce 3 per cent. light and 97 per cent. heat should not make the lighting experts very well satisfied with their products. It is the best we have, but better methods are bound to be discovered.

There is a tremendous reward awaiting the one who learns the secret of developing great powers from the energies stored in these atomic arrangements. While it sounds like fairy tales to talk of getting from these atomic stores enough energy to propel an airship around the world from a supply weighing less than a pound, it does not require any violation of the law of the conservation of energy to do just that. Such an accomplishment assumes an efficient method of conversion, the discovery of which may be a long way ahead of us.

Years Elapse Between Discovery and Application

If these improvements do not take place at an early date, do not be surprised. A certain period of incubation seems to be required to develop inventions to the application point. It took about thirty years, following Watt's invention of the steam engine, for Fulton to apply it to boat propulsion and almost twenty-five years more for Stevenson to apply the steam engine to drive a locomotive.

Coming to more recent inventions, the transmission of messages without

wires was announced in 1897, but radio broadcasting did not come for about twenty-three years. Part of this time is needed to develop the instrumentalities and part is required to allow the public to adjust itself to a condition where it is ready to accept the new methods.

This is fairly well illustrated by the skepticism that greeted announcements of a steam locomotive drawing a train, as recorded in the English publication of *The Quarterly* in 1825, "The gross exaggeration of the powers of the steam engine . . . must end in the mortification of those concerned. Those who are to be whirled at 18 m.p.h. may not be seasick, or scalded to death, or drowned by the bursting of the boiler—they may not mind being shot by fragments nor dashed to pieces by the flying off or breaking of a wheel, but for all that we should as soon expect the people of Woolwich to suffer themselves to be shot off in a rocket as trust themselves to such a machine, going at such a rate."

Think of the change in little more than a century and the general acceptance by the public of electric locomotive speeds of more than 100 m.p.h., of automobile racing cars of more than 300 m.p.h., and of airplane travelling in regular transport service at speeds approximating 200 m.p.h. Higher speeds are freely discussed.

Many amusing statements by some of our most learned men can be found pointing out why certain things can never be; yet today these predicted impossibilities are quite commonplace operations. In looking ahead it is always more dangerous to predict what cannot be done than it is to predict what can. In this latter case it cannot be proved you were at fault; you can always say "it will come later" and no one can prove you wrong. Taking advantage of this I want to predict a great improvement in producing power. Only three-quarters of a century ago more than half of the power used in this country was animal power; today only about 2.5 per cent. is animal and 97.5 per cent. is mechanical. While the improvement of the past twenty years in reducing the pounds of coal per kilowatt-hour from 2.5 to 0.8 is also indicative of real progress in steam power generation, it is still small when compared to the possible energy that would have been gotten had we a really efficient method of energy conversion from that stored in the coal to that finally put on the busbars of the powerhouse. How can anyone believe that man will be content with such inefficient methods and will not seek until he finds others vastly better?

Many Discoveries Come Unexpectedly

Most discoveries occur while looking for something else, that is, they are purely accidental. This is not confined to discoveries in science, for one of our greatest discoverers, Christopher Columbus, made himself immortal as Strickland Gilliland describes it: "He started out on a trip without knowing where he was going and when he got there, he didn't know where he was and when he got back home he didn't know where he had been." But, just the same, he got there.

Generally, in discoveries in science, the unexpected turn taken by some test results in uncovering the wholly unsuspected new thing. In fact, so many unexpected things happen that the experimenter is tempted to forget his main objective and follow these new and very attractive by-products.

I recall an instance of this unexpected phenomena in our own laboratory when Mr. Knowles was experimenting on a form of relay grid-glow tube. He was making observations daily on a group of tubes undergoing a life test. They were located in a rack near a window. The results were erratic, for which he could find no explanation until he observed that they all followed quite closely the weather conditions. On bright, sunny days he got one value for a particular characteristic, while on a dark, rainy day this same characteristic was quite different. With that as a lead he soon discovered the cause was a variation in the intensity of illumination. The effect he described as a photo-electric one and a new tube was constructed with conditions made more favourable for this effect. Such tubes are now used to guard the commutation of certain types of direct-current machines. If the sparking becomes too severe, or an actual flash-over occurs, this tube operates a relay that opens the circuit and stops further damage.

All troubles are not caused by some new phenomena and so do not result in useful discoveries. Sometimes they are due to failure of the designer to use his information correctly. Kettering expressed this quite tersely when he said, "It isn't the things we don't know that aren't so."

One of our research men was detailed to investigate a baffling case of vibration in a power plant. Many unsuccessful attempts had been made to eliminate the trouble by balancing various parts. A careful analysis of this case led the investigator, Mr. Baker, to conclude that it was not due to an out-of-balance condition, but rather to a resonance set up in the pressure-equalizing pipes around the seal of the steam turbine driving the electric generator. By accident, the dimensions of the pipe and the pulsing effect of leakage of the turbine seal, as the spindle shifted endwise, were just right to create a resonant condition which grew to serious proportions. Having definitely decided upon that as the cause of the trouble, the remedy was simple—change the length of the pipe so as to make its natural period of vibration different from that of the period of recurrence of impulsing of the turbine. This change was made and the trouble vanished.

The two examples given show a striking resemblance of the work of the research man to that of the detective. It is in fact quite similar. That is one of the features that adds an interest to the work and gives the real thrill when a solution to the problem is found. There are many Sherlock Holmes in engineering and science, and a large proportion of the cases they have solved have been just as perplexing, and required just as much skill and ingenuity, as that of Conan Doyle's great character in fiction.

Planned Discovery

All discoveries are not made by accident. There are many instances where an investigator has set out to obtain a particular objective and has kept at it until he reached it. The development of the alloy Konel is a case in point. About ten years ago a considerable proportion of the radio-receiving tubes had platinum-iridium filaments coated with barium and strontium oxides. This material was costly—nearly $200 per ounce in the fine ribbon form—and constantly increased in cost, as the demand for more tubes increased. For this and other reasons it appeared necessary to find a suitable substitute. One of the chief essential features of such filament material is sufficient strength at high temperatures. It is essential also that the material should not react unfavourably on the coatings. There were at that time a number of known materials of ample strength, but all seemed to poison the oxide coatings. Dr. Lowry, the investigator to whom this task was assigned, finally solved the problem by taking nickel, which appeared most promising, and combining with it amounts of cobalt and ferro-titanium, he was able to make it not only as good as the expensive platinum-iridium but decidedly better in all respects. This material can be produced for a few dollars per pound, instead of $200 per ounce. Investigations and researches do not always end satisfactorily and, by no means, are a continuous round of successes and thrills. There are many "water-hauls" as the worker pulls in his research net.

It is also surprising, at times, and of course disappointing, to learn how near one was to a satisfactory solution and yet failed to find it. One of our men, as a result of inductive theoretical reasoning, outlined a plan for making a rectifier from copper and copper oxide. He carefully prepared his copper oxide and placed it in contact with various grades of copper, but in every case with negative results. A year or so later, Grondahl produced a successful rectifier of these same materials. The essential difference between his method and the previous failures was that he formed his oxide on the copper that was to be the other electrode of his device. The rectifying properties are related to some peculiarity of the junction between the copper and its oxide as formed. After the oxide is broken from the copper it cannot be returned and made to rectify. One of the two trials with the same materials was successful and the other a failure. The difference was trifling but essential. Strangely enough, too, Grondahl discovered the rectifying properties accidentally as he was seeking an entirely different effect. Scientific exploration takes queer turns.

From the experiences of every laboratory can be related many similar cases. Some of these, with a reasonable amount of latitude in the telling, could be made into interesting detective stories with plenty of human appeal and yet without the sordid details that accompany that type of story, taken from the police records.

What We Can Reasonably Expect

We will have more of the good things of today, but electricity will

not be marching on if its growth is simply one of more of the same. We may expect startling new things in many different fields. New alloys made possible by the accurate control of temperature and atmosphere with the electric furnace are certain.

New permanent-magnet alloys have been produced within the past few years, of strikingly superior properties over those previously used. It is highly improbable that the best combination has yet been found.

Another kind of magnetic alloy, with properties almost the reverse of the permanent-magnet alloys and of much greater value to the electrical industry as core material for transformers and for armatures, will likely continue to follow the march of improvement that has characterized it for the past few years.

New methods of welding many of the more difficult alloys, so as to insure good joints without injuring their special properties, can be expected.

The great field of electronics, which is best known in radio and communication, is overdue for a great number of applications, particularly those having to do with automatic machine operations, inspection of materials, and safety applications. Electronics will play an increasingly important part in electric-power distribution, both in transformations and control.

Radio, now the largest user of electronic devices, has not yet reached the end of its development. Many improvements that give better quality and more reliable results are constantly being made, but we still have serious interferences from static and nearby stations. These must all be eliminated before we can think of approaching perfect radio reception.

A year ago, television, though feasible for short distances, had the serious handicap of no suitable means of chaining stations for national hookups. Today, this handicap, as a result of cable developments, appears much less important. We can confidently expect, in the not distant future, a television service similar to broadcasting as we know it today.

That vast field of air conditioning that is just in the beginning is sure to take a much more important part in improving living conditions. This improvement will give us completely conditioned air, resembling the best attainable at seaside or mountain resorts. It will be balanced in chemical composition, temperature, humidity, cleanliness, and ion content. Those who now find it necessary to seek comfort in remote localities, on account of unfavourable climatic and other conditions at home, can, by means of such air conditioning, enjoy all of these during all times of the year.

Another important field has scarcely been touched by the electrical industry—that of agriculture. It seems strange that a field of such tremendous importance to all should have been passed by so lightly. The possibilities appear almost limitless. In addition to the usual applications of power and light, much can be expected from control of the insects that now infest grains and plants. The seeds that are now carrying these vicious enemies will be freed and given better opportunities for their start in life.

What will be the effect on plant growth, as they are given treatments of these new radiations? No one can tell without extended trials. Plants grown under various colours of light have shown unmistakable evidence of the effects of such differences.

Treatments by some kinds of radiations like X-rays are known to influence the plants' characteristics to such an extent that new varieties are thereby created.

One needs to go but one step more to imagine conditions of selection by some such means that would permit of destroying the undesired weeds, and thus render available for the favoured plants all of the wasted plant food used by the weeds.

It is readily conceivable that the soil as it is prepared for planting can, by electrical treatment, be rendered free from seeds of weeds and thus greatly reduce the labour and expense of subsequent care of the crops. To some the thought will occur—less work, more unemployment. If that is a real point, why waste time in unnecessary and unpleasant effort when there are so many things to do that are enjoyable and useful.

Electricity will play a prominent part in another important field, that of biology, in fact, man himself. The human body is now known to be a complete electrical system with power plant and distribution system. The medical doctor now records voltage produced by the heart as a means of judging its condition. Many laboratories are now engaged in studies, and with some degree of success, that will lead to a better understanding of our bodies and will no doubt enable us to live in comfort.

Certainly much remains to be done before the limit of electricity's usefulness is reached.

—*The Electric Journal.*

Hydro-Electric Progress in Canada in 1935

(*From Bulletin No. 1871, Dominion Water Power and Hydrometric Bureau, Department of Interior, Ottawa*).

THE annual review of hydro-electric progress in Canada, prepared by the Dominion Water Power and Hydrometric Bureau of the Department of the Interior, discloses a substantial addition to the total developed water-power capacity in the Dominion during 1935. New installations aggregating 362,080 horsepower were completed and made ready for operation, thereby bringing the total for the Dominion at the end of the year to a figure of 7,909,115 horsepower.

While the increase in generating capacity is noteworthy, of greater significance is the continued growth in power demand that has taken place during 1935. This is reflected by the monthly records compiled by the Dominion Bureau of Statistics, which show a substantial increase in the output of central electric stations month by month over the figures for the corresponding months of 1934. For the nine months of 1935 for which records have been compiled there has been a total increase of more than eleven per cent. This increase in power output has not been confined to any one part of the Dominion but is evident from coast to coast.

The new installations in 1935 comprised, chiefly, additions to existing developments such as the Canyon plant of the Ontario Government on the Abitibi River and the Beauharnois plant of the Beauharnois Light, Heat and Power Company on the St. Lawrence. Increased activity in the mining industry was responsible for new installations in the Yukon Territory and in British Columbia, Manitoba and Ontario.

The principal activities in hydro-electric development in the various provinces are described hereunder.

Yukon Territory

The Yukon Consolidated Gold Corporation Limited completed the installation of a 5,000 horsepower turbine direct connected to a 4,690 kv-a. generator in its plant on the north fork of the Klondike River, 26 miles from Dawson. This unit is similar to two units previously installed in the plant. The output is used in connection with the company's gold-dredging operations in the Klondike River and vicinity.

British Columbia

New water-power installations in British Columbia during the year were confined to two, both in connection with the mining industry. Bullion Placers Limited completed and put in operation a 500 horsepower installation from which electrical energy is transmitted a distance of five miles to a pumping plant to augment the water supply for placer gold operations at the Bullion mine near Hydraulic, British Columbia. Pioneer Gold Mines of British Columbia Limited installed a 380

horsepower water-wheel in place of a former wheel of 100 horsepower. The net increase in installed capacity in British Columbia during the year was, therefore, 780 horsepower.

Alberta, Saskatchewan and Manitoba

No new power developments were undertaken in Alberta or Saskatchewan during the year but in Manitoba, Gods Lake Gold Mining Company Limited completed and placed in operation a hydro-electric plant at Kanuchuan rapids on Island Lake river. A 1,900 horsepower propeller type turbine is direct connected to a 1,600 kv-a. generator and power is carried to the mine over a 41-mile transmission line.

The Manitoba Power Commission erected 99 miles of transmission line, thereby extending its service to the following towns: Altona, Plum Coulee, Oak Lake, Morden, Winkler, Rosenfeld, Horndean, Gretna, Letellier, Dominion City, Morris, Elie and St. Eustache.

Ontario

In Ontario, the Hydro-Electric Power Commission undertook the installation of three additional 66,000 horsepower units in the plant of the Ontario Government at the Canyon on the Abitibi River. All three units are expected to be ready for operation before the end of the year, thus bringing the Canyon plant to its designed capacity of five units totalling 330,000 horsepower. Early in the year the Commission completed and brought into operation the government-owned plant at Rat Rapids on the Albany River with an initial installation of 1,200 horsepower. A second unit of 1,650 horsepower is being added and will be ready for operation in the autumn of next year. The output from this plant goes to supply the power demands in the Pickle Crow and Central Patricia mining districts to the north of the Albany River. Consideration is also being given to the addition of a 5,000 horsepower unit at the Ear Falls plant on the English River for the supply of mines in the Red Lake district.

The town of Orillia completed and brought into operation its new plant at Workman's Falls on the Gull River near Minden. The installation consists of two 2,600 horsepower turbines direct connected to 2,250 kv-a. generators. A 47-mile transmission line carries the output from the plant to Orillia.

Quebec

The additional hydro-electric capacity installed in Quebec during the year was 100,000 horsepower being confined to the fulfilling of programmes of extension on large plants at Beauharnois on the St. Lawrence and High Falls on Lievre River on which construction had been started before the recent period of industrial restrictions. The actual figure to be added to Quebec's total at the end of 1935 is 150,000 horsepower, as a 50,000 horsepower unit at Beauharnois, completed in December, 1934, was not included in the total for 1934 in last year's review.

The Beauharnois Light, Heat and Power Company, after starting its sixth 50,000 horsepower unit in December, 1934, has placed in operation

its seventh during the month of May, 1935, and completed in the month of September the installation of an eighth unit of the same size. The company has completed all the control works contemplated in the St. Lawrence River for a diversion of 53,072 c.f.s., and has obtained the authority to divert the full 53,072 c.f.s. authorized by the Statutes of Canada.

The MacLaren-Quebec Power Company is adding a fourth 30,000 horsepower unit to its High Falls hydro-electric plant on Lievre River to be completed in February, 1936, thus bringing the development to its total ultimate capacity of 120,000 horsepower.

An important step has been taken by the Quebec Government in extending the powers and activities of the Quebec Streams Commission to actual development and utilization of water-power sites, the operation of plants and production and transmission of hydro-electric energy as well as its purchase from other central electric stations and its resale to municipal systems or other consumers. The Streams Commission is also authorized to acquire or expropriate power sites already conceded by the government but not being exploited, while by agreement with the owner it may acquire any utilized development.

Another notable measure taken by the Quebec Government along similar lines was the creation of the "Quebec Electricity Commission" with wide powers to regulate the operations, rates and other matters connected with production and distribution of electrical energy in the Province.

Other legislation along the same lines provides for and facilitates the municipalization of electrical energy, giving municipal councils certain rights in connection with the establishment of electric systems. This also includes government help to rural electrification and encourages necessary extensions to transmission networks. It is reported that many municipalities intend taking advantage of the latter and their applications are being considered by the Commission.

New Brunswick

No new hydro-electric installations were undertaken in New Brunswick during the year but the New Brunswick Electric Power Commission has under way the addition of one 6,250 kilowatt turbo generator to the equipment in its fuel station at Newcastle Creek. It is expected that the new unit will be ready for operation about March 1, 1936.

Nova Scotia

In Nova Scotia, the Nova Scotia Power Commission has in course of installation a new unit of 4,300 horsepower at its Ruth Falls generating station on East River Sheet Harbour. This is scheduled to go into operation about the first of February, 1936.

R. E. Garrett, Sarnia

Robert E. Garrett

Robert E. Garrett, Secretary-Treasurer of Sarnia Hydro-Electric System, died in the Sarnia General Hospital on the evening of Sunday, December 22nd, 1935, aged 56 years.

Taken seriously ill on Wednesday, December 11th, while at the office, he was rushed to his home where he remained in a critical condition. On Saturday, December 21st, he was taken to the hospital to undergo an operation, in the hope of saving his life, but the operation was too severe for his physical condition. The funeral was held at Sarnia on the afternoon of Thursday, December 26th.

Mr. Garrett was born in Moore Township, Lambton County, and came to Sarnia in the early 1900's and joined the office staff of Thomas H. Cook in the express business. Later he went to the office of the McGibbon Lumber Company where he remained until 1915, when he took over the operation of a grocery store. In August of 1916 he became Secretary-Treasurer of the newly formed Sarnia Hydro and when the Sarnia Hydro-Electric Commission was formed in 1917, became Secretary-Treasurer of this body. This position he held until his death.

Mr. Garrett was perhaps one of the best known men in the City of Sarnia, as he was actively connected with fraternities and with sports. He also became widely known in Hydro circles throughout Ontario and at the time of his death was Secretary of Group No. 10 of the Western Ontario Electric Association.

The Sarnia Hydro-Electric System Commissioners, Manager and Staff feel very deeply the passing of Mr. Garrett. George N. Galloway, Chairman of the Commission, has stated—"We have lost a faithful and valuable employee and the city has lost a good citizen. Mr. Garrett was an exceedingly active man in many walks of life and was most popular in Sarnia."

Surviving him are his widow and two sons, to whom we extend our sympathy in their loss.

Selling Industrial Electric Heating

By J. F. Thomlinson, Power Engineer, Toronto Hydro-Electric System.

(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1936.)

SELLING industrial electric heating is still very largely a matter of education. To-day we still find some of the same reluctance to replace fuel fired equipment with electric heat that twenty or thirty years ago was encountered in the electrification of motive equipment, even though electrical methods can show advantages over the method in use.

The first cost of electric heating equipment is very often considerably higher than the cost of comparative fuel fired equipment but this need not discourage you in trying to introduce electric heat. In all our electrical development first cost has not been the deciding factor. Electric light replaced coal oil lamps and gas lighting. Electric irons replaced sad irons. Electric washers replaced washboards. Motor trucks replaced the horse and wagon and so on, although a greater investment was required in each case. However, the difference in investment was offset either by improved product or greater speed so that we found total cost to be less by the use of more expensive but more efficient equipment.

And so it is with electric heat in many cases. That the development of the art of industrial electric heating has been comparatively slow is due partially to the conservatism of Canadian business which seems to have a strong disinclination to change established customs. But when the barrier can be broken down and electric heat has been introduced, it has over and over again established a new standard of comparison and has produced operating results and conditions of superiority beyond anything previously experienced, demonstrating that electric heat is economical, that it produces new standards of quality and that the most exacting operating conditions can be met and reproduced simply and automatically with reliable accurate temperature control.

It is generally thought by a prospective user that electric heat is too expensive when compared with other methods. If the comparison is made simply on a heat content per unit bought basis, this would very often be true. But comparative cost estimates based solely on the British Thermal Unit heat values of fuel and electricity are decidedly unfair to the electric method. They do not take into account the fact that electric energy is converted 100 per cent. into heat energy whereas whenever fuel is burned, only a portion of its potential heat energy is actually released and made available for use. For many types of fuel fired equipment conversion efficiencies as low as thirty to forty per cent. are the rule rather than the exception. Then, too, in the

application of electric heat to a process heat losses can very often be reduced since no chimney carrying off heat along with the products of combustion is required and excess air necessary to support combustion is not required with electric heat. The only fair basis, therefore, to compare electric heat with fuel is on the basis of the resultant unit cost of the finished article. This will, of course, involve a very careful analysis of all the factors entering into cost, including maintenance, cost of furnace and auxiliaries, cost of rejects, the effect of working conditions on production, cost of transportation of parts to and from heat treatment department—this cost can often be eliminated in the case of electric heat treatment since the electric furnace can be placed right in the production line. Improvement in the quality of the product can sometimes be evaluated. Fuel equipment makes necessary extra cleaning and painting of premises which sometimes can be evaluated.

It must be admitted that too many business executives are only too little familiar with the real cost of their heating processes. They are disposed to figure only so many pounds of coal at so much or so many gallons of oil or cubic feet of gas. However, education carried on over a period of years is gradually bringing realization that there are some other factors entering into the cost of heat treating a product in addition to fuel cost.

Edgar A. Wilcox, B.S.E.E., in his book "Electric Heating", published in 1928 by McGraw-Hill, lists a number of conditions under which in his opinion the use of electric heat in a process is warranted. And by the way, this book is in the writer's opinion a most excellent text book for any one interested in the promotion of industrial electric heating.

He says "The use of electric heat generally is warranted when careful analysis indicates that one or more of the following conditions prevail:—

(1) When, due to opportunity for more efficient application, it is actually found to be cheaper than other methods.

(2) Where it speeds up production, thus reducing unit costs.

(3) When the over-all costs are cheapened due to lower labour expense, elimination of rejects, or reduction in fixed costs of equipment, auxiliaries or floor space.

(4) When its possible higher cost is justified because of improvement in product.

(5) When the possible higher cost is warranted because of improved living or working conditions, safety, convenience, cleanliness, dependability or accuracy of control.

(6) When operating costs are of minor importance compared to the results to be accomplished.

(7) Where other forms of heat cannot be applied."

This does not mean that wherever the above conditions exist you will be able to sell electric heating but if one or other of these conditions do exist, as shown by a careful analysis of existing conditions, then you do have a definite prospect for an electric heating proposition.

Until recently data based on experience has been woefully lacking in support of the claims as to the savings made in industrial electric heating applications and the Canadian busi-

ness man, as you know, is not one to be sold by general statements as to savings neither is he interested in any proposition which would require a long period of years to liquidate his investment. In talking with prospects we must offer definite facts backed up by operating experience and a sufficient return on the investment to make it worthwhile.

Accordingly we have found it very helpful to keep a complete record of all the jobs we have handled with sufficient information to indicate how the problem was solved together with operating data. Many times we have been able to refer back to these jobs in selling a new proposition.

In this connection I might say that any of the information that we have collected during the past fifteen years that we have been interested in the promotion of industrial electric heating is available to any of you that has a particular problem to solve. If you think that we can help you, drop us a line and you will be welcome to any data we have bearing on that particular problem.

In selling industrial electric heating, one of the problems is to decide who in the plant is the right party with whom to discuss the matter. In the first place you should be familiar enough with the plant to know the heating proposition in which you are most likely to interest them first. Having decided upon your point of attack, you then must decide how you will make the attack. Perhaps the plant electrician is the man you should see first or perhaps it is the operator of the particular piece of equipment you would like to see electrified. In only a very few cases is the manager or the purchasing agent the right party to see first. Granted you will probably have to see them in the end, but by discussing the matter and working out a proposition with those directly interested in the use of the equipment you get information and arguments that strengthen your hand against the time when you will actually have to sell the management. Further, if you can get the operators wanting the equipment badly enough, half your battle is won. In other words wherever possible let them sell themselves on the idea. They will then be much more enthusiastic towards it than if it is sold to them and you will find them working with you to sell it to the management.

If we are to increase our industrial heating load we must be prepared to give the consumer a certain amount of engineering advice. In some cases all that will be necessary will be to indicate to him how to place heating elements and how to heat insulate the equipment. In other cases you will have to submit complete plans and specifications. A word of warning—some jobs can be engineered to death. I have in mind a simple application of strip heaters that we allowed to get away from us because a certain manufacturer's representative permitted his enthusiasm for complete automatic temperature control to run away with him. He had the job so complicated and expensive that the consumer threw up his hands in disgust, whereas a little careful handling and a little more common sense would have indicated that three-heat snap switch control was all that was required for this job. We fell down on this job too because we gave

the manufacturer's representative too free a hand. You will have to size up your prospect yourself and decide how much you may leave to him to work out for himself or how much may be left to a manufacturer's representative or how much you will have to do for yourself.

Publicity is the greatest aid in the spreading of the gospel. Your consumers are usually not adverse to a little extra free publicity, so any interesting application of electric heat is worth while writing up and submitting with a photograph of the installation if possible to some of the journals interested in the dissemination of electrical knowledge. Of course in every case you should secure the permission of a consumer before releasing such information for publication. We have found that in most cases they are only too glad to give such permission.

We have always had the most excellent co-operation of all the manufacturers of industrial electric heating equipment. It must be realized, however, that on the smaller jobs they cannot afford to send a man out in every case. We must remember that they make only one profit on the sale of the equipment whereas we continue to get revenue as long as the equipment stays on our lines. The manufacturer has done his part in providing a line of equipment including standard heating elements in sufficient variety of types, shapes and sizes to handle almost any heating proposition. It is now our job to get this equipment on the lines. Methods of application and quantities required for various jobs in the smaller class must be worked out by us if we expect to progress in this field.

We have found that sometimes it helps to sell a job to give an actual visual demonstration of some of the smaller heating appliances such as glue pots, urn heaters, etc., and we have found the manufacturers willing to co-operate to the extent of loaning us the equipment with which to demonstrate.

What sort of heating loads are being secured to-day? Well, here are a few of the more recent jobs installed in Toronto and vicinity. To mention the largest jobs first, though we did less actual work on them than on many of the small jobs, a large metal company has installed during the last twelve months two heat treating furnaces, totalling 375 kw., a core baking oven, rated 50 kw. and two metal melting pots, totalling 52 kw. One of the heat treating furnaces replaced an oil fired furnace for heat treating sheets while the other was an additional furnace for heat treating an automobile part, for which electric heat treatment was specified by the automobile company. To show you how electric heat grows once you have the initial installation, the above company in March, 1930, had a heating load totalling 500 kw. and to-day the total is approximately 1,000 kw.

The automobile manufacturers more and more are specifying electric heat treatment of automobile parts. The ever increasing speeds imposing much more drastic service has brought into use in the automobile field expensive alloys requiring careful heat treatments to bring out to the fullest their

strength giving properties. Heat treatment cycles accordingly have become more complicated and must be held within closer limits if successful results are to be duplicated day after day—therefore electric heat.

Another company making automobile parts added a 102 k.w. conveyor furnace and I have been advised that within the next few months they will be electrifying their cyanide pots which will probably mean another 120 kw. They already had a large conveyor furnace rated 240 kw. for normalizing gear blanks.

Still another has recently installed an annealing furnace for small parts rated 45 kw.

The Provincial Department of Mines has recently installed a 23 kw. Globar furnace for assay work. This is in addition to an existing smaller furnace.

The first large glass annealing lehr was installed in Toronto this year. It is rated 20 kw. and is used in annealing druggists' glassware and is doing an excellent job. Here is a field that has been hardly touched as yet. Optical glassware is pretty generally annealed in electric lehrs but the other types of glassware are mots often annealed in fuel fired equipment.

There have been a number of plating tanks and cleaning tanks equipped with electric heating units during the past year. The average installation totals 5 kilowatts.

Electric glue pots, cartridge heaters for heating stamping dies, etc., strip heaters and the smaller heating devices continue to be installed in ever increasing amounts. One manufacturer of jewellery boxes is now using 6 kilowatts made up entirely of small cartridge heaters, the average rating of which is 120 watts.

And to illustrate what can be done by the small man, one of our consumers, a tool and die maker, has built himself a small hardening furnace using two Globar heating elements, totalling 1,800 watts and has equipped it with an automatic temperature control of his own devising, the simplicity of which is surprising and yet it is doing an excellent job as far as his requirements are concerned. He intends now to build himself a tempering bath. He has been using the hardening furnace for tempering by allowing it to cool down to the required temperature but expects to have sufficient work for the hardening furnace that he will have to have a separate tempering arrangement.

Another man is working on a home-made furnace for melting bronze to be used in casting statuettes. He expects to be able to use Globar for this application. He has already built himself an electrically heated core baking oven.

The newspaper industry in Toronto is a large user of electric heat. The two evening papers use a total of approximately 1,500 kw. in melting stereotype metal. About 210 kw. of this was added last year.

Another application in course of installation is an electric pre-heater for fuel oil in a large bakery.

These examples will give you some idea of the very wide field for electric heat entirely aside from its use for electric cooking.

Hot Magic

By Paul W. Kearney

DO you like parlour tricks? Well then, try this: Soak a blotter with oil of turpentine and put it in a jar of oxygen gas. The gas will promptly burst into flame.

You have no oxygen gas around the house? All right, here's a simpler trick: Take one oiled mop and put it in the closet under the stairs. If the conditions are right, your whole house will burst into flame in a couple of days. It's most impressive, and, in fact, is America's most popular specimen of parlour magic.

This amazing phenomenon of spontaneous ignition is vaguely familiar to many of us as a hazard of damp hay in barns or, perhaps, painter's overalls in the closet. But by believing that this threat is limited to a small field, thousands of householders constantly lay themselves open to treacherous fires.

For example: In New Jersey not long ago a man got a faint odour of something burning in his cellar. Quite by accident he discovered the cause. A stack of old newspapers under the stairs was smouldering from the inside out, and if he hadn't happened to bump into the pile and knock some off the top, he would have had a dangerous fire.

A surburbanite near Dayton, Ohio, bought a couple of rose bushes and saved the burlap wrapping which had been around the roots, rolling it neatly and placing it on a table in the basement. Several days later the maid smelled smoke in the house; it was coming from the burlap roll on the table. Puzzled, she poked it with a rake and instantly it burst into flame.

Any vegetable or animal oil on a combustible material is a potential menace, because natural oxidation of that oil generates heat which may ignite the material. The burlap must have had oil on it—or perhaps fertilizer from the rosebush roots. The newspapers had printer's ink on them; there was just the right amount of moisture, just the right degree of ventilation for the chemical forces to work.

In Massachusetts a woman one afternoon discovered a mattress smoking furiously. Dousing it with water, she threw it into the yard to dry. Next morning she discovered that it was smoking again. She telephoned the firehouse and when the fireman ripped open the mattress, it burst into flame in seven different places! Somewhere in the process of manufacture, oil may have been spilled on the cotton stuffing and eventually the hot-magic trick came off. Yet it could happen even more directly. For instance, castor oil or camphorated oil used for a sick person might be spilled on a bed, soak into the mattress, and later cause trouble.

Even stranger things have occurred. In Maine a woman went into her attic to get an old dress. When she took the lid off the basket in which the dress was stored, she was startled to find nothing but a handful of ashes. That dress had been made of black

silk, a notorious breeder of spontaneous ignition. Indeed, there's a record of a shipment of silk which caught fire once on the ship at sea and twice in the warehouse where it was stored.

One could go on indefinitely citing such cases of hot magic: a raincoat hung in a closet; a bunch of Florida moss dipped in varnish for decorative purposes; an old pile of furnace ashes kept too long in a damp cellar; chips in the bag of a floor shaver used on a waxed floor (this one cost 48 lives in a Pittsburg home for the aged); floor sweepings (especially when mixed with oily dust-laying compounds) waiting in a bag for the trash collector. Probably the fastest case of spontaneous ignition on record occurred in a railroad station where a closet burst into flame *one hour* after a painter hung his oily overalls there. And one of the oddest outbreaks involved a keg of iron filings kept on an oiled floor. The oxidation of the oil heated the iron to the point where it ignited the wooden keg.

Relatively few homes are free from piles of discarded junk where this threat may lurk. The large-scale remedy is to throw out this stuff which clutters up the cellar and attic. Floor sweepings also should be thrown out at once. The secondary defense is to be extremely careful with such oily things as mops, paint rags, waxing and polishing cloths, and the like. If stored indoors, they should be kept in tightly closed metal cans; those which can't be safeguarded thus should be kept outdoors where they get plenty of air. Remember that a limited amount of oxygen and a certain amount of dampness—as in the time-honoured closet—speed up oxidation.

Another cause of mysterious fires is the misuse of electricity. The *forgotten* electric iron alone is charged with 37 per cent. of our electrical outbreaks. Next comes the abused extension cord which, trampled under foot, squeezed in doors, hung on nails, and subjected to numerous other extraordinary punishments, finally gives up the ghost and blows out. One of our greatest mistakes is in buying fixtures with flimsy, sub-standard cords which do not bear the approved label of the Underwriters' Laboratories.

The careful householder disconnects all lamp cords before leaving the house vacant for any substantial period of time. There's current in the cord right up to the switch and a rupture in the cord will scatter a shower of sparks (usually white-hot metal) all over the place. If you could scan the fire patrol reports and see the number of blazes every day which start "behind a divan," "under rug near door", "in portieres near floor lamp", you'd appreciate how much trouble the unnoticed extension cord gets us into.

The tampering of the handy man about the house—amateur additions to the electric installation—causes more blazes than you could shake a dozen sticks at. The least excusable form of this tampering is the business of monkeying with the fuses—putting in heavy fuses when lighter ones blow out or, worse yet, bridging the fuse with a penny or other metal to eliminate the bother of replacing the plugs. No one knows how many dwellings have been sacrificed to this stupidity.

A fuse is the safety valve of the electric circuit, intentionally made

weaker than the rest of the line so that any overloading will cause the break to come there rather than in some hidden wire. Yet circumventing this safeguard is so widespread that in one small city fire inspectors collected a bushel basket of bridged fuses and over $4 in pennies taken out of fuse boxes in a three-day checkup!

This problem of overloading is more vital in an old house than in one with new wiring, because installations made 10 or 15 years ago didn't anticipate the present popularity of electrical appliances. In such a house it's urgent to have an electrician investigate any frequency of blown fuses before you make the error of over-fusing the line and throwing an undue burden on the wiring.

After all, simple precautions—nothing more than careful housekeeping and a greater respect for electricity—will solve the problem of the hot magic which at present is costing us upwards of $50,000,000 a year in fire losses.—Condensed from *The Family Circle* in *Readers Digest.*

A. M. E. U.

Report of Regulations and Standards Committee

The Regulations and Standards Committee of 1934 reported having protested against the recommendations contained in the report of the National Research Council made at the request of the Hon. H. H. Stevens as Minister of Trade and Commerce in the matter of shortening the period of Reverification of Electric Meters.

This year's Committee continued the efforts of the previous Committee and were represented by Mr. W. P. Dobson, Mr. J. Eckersley and the writer at a Conference held in the Office of President Tory of the National Research Council at Ottawa on April 12th, 1935.

A very thorough discussion of all the points involved in the report was participated in by Dr. Tory, Dr. Boyle, Mr. Grant (the Author of the Report) and Mr. J. L. Stiver of the Gas and Electricity Inspection Service and your Representatives as well as Representatives of private Utilities from Quebec. At the conclusion your Committee was given to understand that the recommendations included in the report would be modified when presented to the Minister of Trade and Commerce.

The Committee held a Breakfast Meeting during the Bigwin Convention in July and discussed the matter of proper protection of single phase motors supplied at 220 volts or more from a three-wire bus and operating automatically controlled refrigerating, air-conditioning or similar equipment.

It was felt that the new proposed code (which has since become effective) did not require adequate protection for the above type of service.

The attention of the Canadian Engineering Standards Association has been drawn to lack of proper protection required under the existing rule and a suggested re-wording of the clause has been submitted for the Association's consideration.

Signed,

H. F. Shearer,

Chairman.

THE BULLETIN

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Modern Lighting Applications

By Geo. G. Cousins, Engineer in Charge of Illumination, H.E.P.C. of Ont.

THE word "modern" naturally implies relative newness but generally there is no line of distinction between modern things or accomplishments and not modern. It is particularly so in this case as lighting has been steadily advancing year by year for many years. Consequently, as "modern" is not definitely defined, an attempt will be made to point out some of the accomplishments in lighting that represent recent tendencies in the application of light, the use of new types of lighting equipment or new uses for lighting.

The most distinctly modern phase of lighting as applied to public buildings, is that it is free from the restrictions of tradition and is included in the planning of buildings rather than something that is added later.

This procedure makes possible the attainment of results that were impossible under the old order. Large areas of light source, panels and ceilings are successors to suspended fixtures and the diffusion and distribution of light more nearly approaches the broad distribution of nature's light.

A new appreciation of the value of light in promoting the welfare of human beings has given a great impetus to the application of knowledge that has been accumulating for many years.

Modern lighting requires more careful planning, high intensity must not be accompanied by increased glare and the light must strike the work in such a way that it is most effective. This calls for an accurate knowledge of the characteristics of the many types of lighting equipmen[illegible]ight be interjected here th[illegible]ome of the manufacturers are [illegible]y lax in supplying engineeri[illegible]ormation relating to their eq[illegible]ment. The candle power distrib[illegible]on curve which has not generally received the attention that its importance justifies is now becoming an essential feature of the information upon which lighting systems are planned.

New Lamps and Fixtures

The only distinctly new lamp is the gaseous conductor type such as the sodium and the high intensity mercury. On account of the violent

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FEBRUARY, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

colour distortion of the yellow sodium light, its use is at present restricted to outdoor lighting.

The mercury lamp also causes strong distortions of colour but when used in combination with tungsten lamps a good white light is produced that has many useful applications.

The most valuable feature of these lamps is their high efficiency which is about twice the efficiency of tungsten lamps of corresponding wattage. In these day's when higher illumination intensities are demanded, the ability to produce twice the intensity for the same watts is indeed a valuable feature.

The mercury lamp has possibilities for industrial lighting although there are some features that must be taken into consideration such as the delay of fifteen to twenty minutes in restarting after an interruption in the circuit and the flicker. All gaseous conduction lamps have more pronounced flicker than tungsten lamps, and the effect of the flicker must be determined by trial. Rapidly moving parts of machinery may cause stroboscopic effects that might be troublesome to operators. When used in combination with tungsten lamps, both these effects are moderated to some extent. After an interruption, the tungsten lamps will restart immediately, furnishing about half of the normal illumination of the complete unit until the mercury restarts and the steady burning of the larger tungsten lamps makes the flicker less troublesome.

Full advantage of the high efficiency of these lamps can only be taken in high intensity lighting as the highest efficiency is obtained from the larger lamps.

It is the common practice in Europe to correct the power factor of gaseous conduction lamps to 80 per cent. before they leave the factory.

Combination Units

The blue-green predominant colour of the mercury light is the colour that the tungsten lamp is deficient in, so that by combining the two in the proportion 1.5 to 2 watts of tungsten to 1 watt of mercury, a close approach to white light is produced at an efficiency of about 24 lumens per watt, which is five or six times the efficiency of the same quality white produced by filtering out the excess red and yellow from tungsten lamp light. There are many industrial operations and stores where white light is necessary for the former and, at least, desirable for

Efficient coloured flood lighting with gaseous conduction lamps.
(Photo, General Electric Co., London.)

the latter. These combination units thus make practical the use of white light at high intensity where the cost has formerly been a deterrent to its use.

Tubular Lamps

To meet the requirements of architects and designers of lighting equipment for special effects, a number of new lamps have been developed mostly of the tubular form. There are two distinctive features of these lamps. The filaments extend the full length of the tubular bulbs and when placed end to end, the dark gap between is only about ½ inch. They can be made in curved forms and the ease with which they can be worked into patterns makes them particularly suitable for decorative use. They are used a great deal in show window trimmings.

Tubular lamps make possible concealed lighting equipment in a very much smaller space than was possible before, such as cove lighting for small rooms. The lighting of many forms of show cases is another good example of their use. The beauty of panel lighting depends largely upon uniform surface brightness and this can be accomplished with greater ease and in smaller spaces with tubular than with regular service lamps.

It is well to bear in mind that special lamps are usually higher in cost and lower in efficiency than general service lamps and when results can be obtained with the latter is more economical to do so. The new lamps, however, open up new fields for lighting and when their special features can be utilized, the additional cost is justified.

The development of tungsten lamps and the light control accessories to be used with them has reached a stage

Example of the use of tubular lighting.

that enables us to completely discard the old idea of the lighting fixture that must be suspended close to the work and to build the lighting system into a building as part of the structure rather than something that is added on later. This applies more particularly to public buildings and buildings for other than industrial use. It offers new possibilities for lighting the home. It is essential that all such lighting be planned as part of the building.

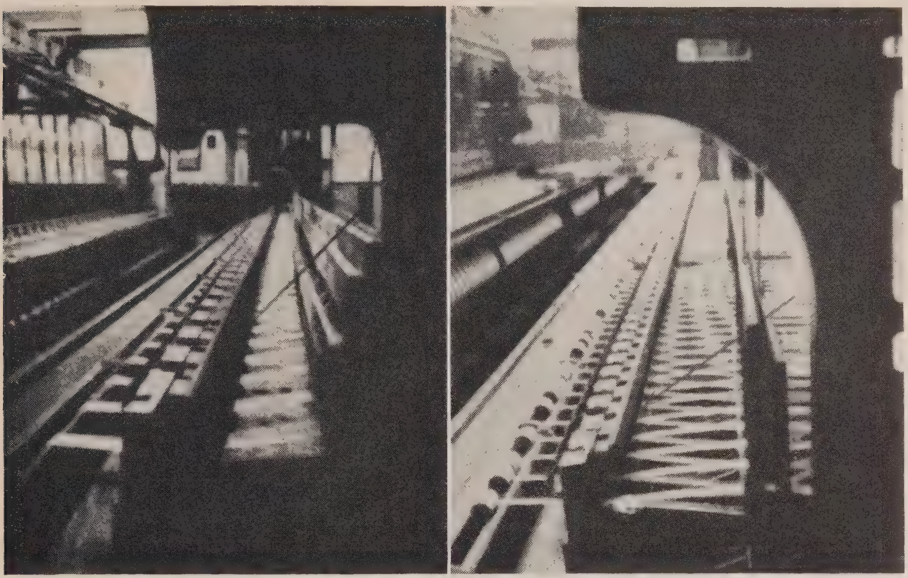
A stage has now been reached where the refinements of lighting are given full consideration. The lighting equipment of new public buildings provides a very broad distribution with very low brightnesses that is a much closer approach to outdoor daylight characteristics which are considered ideal. Of course, the interior intensities are far from daylight intensities but the improvement in the lighting is a distinct advance.

Directional Lighting

We are at last coming to realize that illumination intensities just a few degrees better than moonlight are not sufficient for the ordinary visual tasks in our work-a-day lives and the problem of providing desirable intensities involves considerations of expense and a viewpoint from a new angle. High intensities are required on the work and it is not always necessary to provide the same intensities throughout the surrounding area although the general illumination should not be less than 10 per cent. of the high intensity.

By careful selection and placing of the lighting equipment, it is often possible to localize the high intensity over the important areas and the stray light will provide the general illumination.

In the ordinary type of lighting installation where the outlets are placed and the height of the fixtures decided upon to produce reasonably uniform illumination, the assumption is made that there will be sufficient light so that vertical surfaces will receive a fair share which, however, will be lower than on horizontal surfaces and all parts of the interior will be illuminated to approximately the same intensity. It frequently



The arrow on the left indicates a shadow that reduced production. The view on the right shows the same operation after the shadow had been eliminated. Increase in production 12 per cent.

happens that this is not the most effective method of applying the light.

In stores, particularly those with broad aisles, the lighting can be so planned that the counters receive light directed on to them and the stray light is sufficient for the aisles. This places the light where it is most valuable and enables the merchant to have the benefit of high intensity without unnecessary consumption of power.

Directional lighting is of particular advantage for many kinds of work where the individuals face the same direction all the time. Typewriting is a good example of this where light is required on the copy holders which are practically vertical. Properly designed directional lighting illuminates the work from a natural direction. School lighting is another application of directional lighting. All this is more efficient lighting in the real sense, that is lighting produced where it is needed and in such a way that its purpose is most effectively fulfilled. This efficiency need not be obtained at the sacrifice of good appearance of the lighting equipment.

References to efficiency are not intended to infer that engineering efficiency is the most important phase of lighting but in the attainment of the higher intensities, the economical aspects cannot be ignored, particularly when illumination is used for monetary purposes.

Coloured Light

For display and spectacular lighting, colours are finding an ever increasing application. The production

A good example of inexpensive directional lighting.

of coloured light by tungsten lamps is a very wasteful process; coloured filters are used to absorb all but the desired colour and the other colours are wasted. By this method, a clear tungsten lamp with an efficiency of 16 lumens per watt will produce yellow light at about 8 lumens per watt, red at about 2 lumens per watt and blue at about 1 lumen per watt. This puts a very severe restriction on the use of coloured flood lighting except on buildings of very light tone.

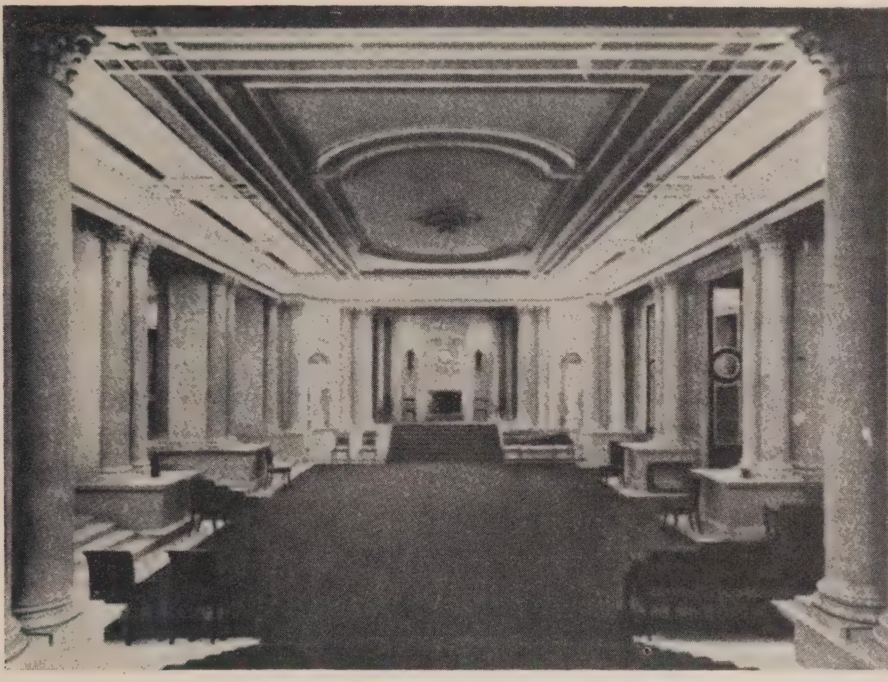
The availability of yellow sodium light at 40 to 50 lumens per watt, red neon at 10 to 15 lumens per watt and blue or green from high tensity mercury at about 12 lumens per watt opens up new fields that have not yet been touched and on a scale that has heretofore been prohibitive in cost.

In Europe, by means of fluorescent linings in the glass tubes, there are available twenty-three colours in 44 m.m. tubes (1¾ in.). These fluorescent linings increase the light output of the unit nearly three times the output of the clear glass tubes.

Gaseous conductor lamps cannot be concentrated into small areas and are, therefore, not suitable for long distance projection. They are well adapted for close-up lighting of building faces. Lamps of this type can now be dimmed and this facilitates the blending and changing of colours.

In England, coloured flood lighting is being used on an ever increasing scale. The red neon is particularly well suited to red brick. It is reported that sodium light shows buildings blackened with age much better than the same colour and intensity of tungsten lamp light.

Lamps combining utility and decoration in an unusual manner.



Buckingham Palace—The Grand Hall. An example of indirect lighting carried out by means of architectural lamps concealed in troughs designed to appear as part of the existing cornice moulding.

Gaseous conduction lamps are used in flood light projectors specially designed for them.

School Lighting

In spite of all the emphasis that has been placed on school room lighting, progress has generally been slow. However, in the lighting of rooms for sight saving classes, an important advance has been made. A few such class rooms have been lighted to intensities of from 30 to 50 ft.c. In one case, the fixtures were combination tungsten and low pressure mercury vapour proportioned so as to approximate daylight colour.

The children in these classes are usually more sensitive to annoying influences than normal children are and it is necessary to avoid, as much as possible, anything that might be distressing. It is well known that the transition period from daylight to twilight is a very difficult part of the day to provide for, due to the difference in colour between daylight and ordinary artificial light. In the room under consideration, the combination lighting blended with and matched daylight so well that keen observers could not detect any difference and this effect, combined with the high efficiency, materially assisted the pupils in their work. This type of lighting has been heartily endorsed by those interested in this special phase of school work.

This is an outstanding example of the value of daylight quality of light as a practical means of overcoming a difficult lighting problem.

Plant Growth and Flower Control

For many years, experimentation has been conducted on the effect of artificial light in stimulating the growth of plants and controlling the time of flowering when climatic conditions are adverse. It has recently been found that quite moderate intensities, of the order of 20 ft.c., and lower have enabled horticulturists to place their wares on the market at seasonable times regardless of climatic conditions. For instance, with pansies, the power at 5 cents per kw-hr. cost 4½ cents per 100 blooms. This was at Lafayette, Ind. The wholesale price was $1.00–1.50 per 100 blooms during the spring. The cost of power for asters under similar conditions was 16½ cents per 100 blooms when the wholesale price was $3.00 per 100 blooms. In our more northern latitudes with lower power rates, the use of artificial light may prove a valuable aid to florists. Artificial light produces longer stems and larger flowers as well as earlier flowers.

The time and intensity of the artificial light stimulation varies with different plants but with pansies, stocks and asters, five hours at 16 ft.c. gave about the best results.

Industrial lighting units assembled in groups of five or six, provided with chains and hooks for suspension from the framework of the building and flexible cord for connection to the circuits will enable the florist to use them wherever they may be needed or to be removed when not needed.

Florists have been interested in this subject for some time but the commercial phase had not reached a stage to encourage them to adopt artificial light as a regular adjunct to their business. The power used is off-peak power and with low rates the florists of Ontario are exceptionally favoured with a practical means of overcoming the effects of adverse weather on their business.

Garden Lighting

A well kept flower garden is really a thing of beauty that gives enjoyment to all who behold it which need not cease after sundown. By the judicious use of small pieces of inexpensive lighting equipment, the garden can be transformed at night. It is not necessary nor desirable to attempt to imitate daylight effects but better to illuminate localized groups or special features of the garden by lighting units concealed in the foliage or shrubbery. Every garden is an individual problem and the taste of the owner is the only guide to be followed. Figures of birds, animals or grotesque human figures can be utilized to conceal and hold lighting equipment as well as add interesting details of the garden.

The lighting of a pool is particularly pleasing. Under-water lighting is the most effective. A simple method of installing it is to make one or more enclosures in the masonry forming the sides of the pool that will hold 100 or 200 watt reflecting units separated from the pool itself

An excellent example of adapting lighting equipment to architectural details.

by watertight glazing. If possible or convenient, conceal the actual openings so that from ordinary directions of view the light sources will not be visible. Metal imitations of water lily pods have been made that conceal lamps secured to their under sides.

By the employment of a little labour, some sockets, lamps and cord, and a little taste, a garden that has lost its interest because of darkness can be transformed into a delightful place to sit during the cool of the evening, or if exposed to view from the street, it becomes an added attraction in the neighbourhood.

This is a most fascinating branch of lighting that yields large returns in satisfaction for a small outlay in time and money.

A word of caution is necessary regarding the importance of grounding exposed metal parts of the units. The cords and fittings should be made with rubber covering on all metal parts, and the lighting units themselves should be installed in such a way that danger of electrical shock is eliminated. This equipment will be exposed to rain and water from the hose and fatal accidents might easily happen if proper precautions are not taken.

Residential Lighting

Personal taste has such a powerful influence on the lighting of the home that it may be said that nothing else counts. There is, however, definite evidence that the lady of the house is weakening considerably in her re-

Left—The Shell service station is of translucent glass plates and steel construction. Right—A luminous building stands out distinctly from its surroundings.

sistance to a change in favour of lighting for seeing instead of lighting for mere effect. Eyes demand the same conditions for seeing in the home as they do elsewhere and if we value our eyes, the wisdom of altering our ideas of decoration in favour of our eyes is obvious. This change is taking place and after the shock has passed and the occupants have tasted the benefits of good lighting, they become enthusiastic over its effects.

The distinguishing feature of the new idea is the general illumination of a room which may be produced by lamps of the I.E.S. types or other means which is supplemented by local light from portable lamps when needed. The new tubular lamps are well adapted to indirect cove lighting without obtrusive large coves to conceal the lamps and reflectors.

The keynote of living room lighting, in particular, is flexibility. With cove lighting, it is a simple matter to connect the lamps in groups so that different intensities and colours of illumination may be had by utilizing one or more circuits. The new three-light semi-indirect and indirect lamps also permit the carrying out of this idea on a more restricted scale.

New ornamental devices are always interesting. The combined floor lamp and flower stand furnishes a rare combination of utility and beauty. They provide a pleasant touch of bright foliage or flowers that is so generally lacking in the living room at night.

Conclusion

Never before, in the history of the lighting industry, has there been manifested such a keen interest in lighting as there is at present. The value of light is being recognized and

light is being used in many ways that were unthought of a few years ago. Indications point to a more liberal use of light for seeing and for decorative purposes. The success of a lighting installation depends upon the care bestowed upon its planning. The importance of the choice of proper lighting equipment for a particular purpose demands a more intimate knowledge of the principles of light control in order to utilize larger quantities of light to the best advantage.

Modern lighting is the application of principles long known that has been made possible by the replacement of interest for indifference and confidence in the ability of lighting engineers to analyze a lighting problem and supply the need.

Acknowledgement is made of the use of illustrations from the publications of the Illuminating Engineering Society, the General Electric Company, the Westinghouse Electric and Manufacturing Company and the General Electric Company Limited of England.

W. J. Hermeston, Walkerton

William James Hermeston, Commissioner, Walkerton Hydro-Electric Commission, died suddenly at his home in Walkerton on Wednesday, February 12th, 1936. Although he had not been in the best of health and spirits for the past few months, there was nothing to give cause for anxiety about his condition. After being about town as usual on Tuesday afternoon and seeming in health during that evening, he retired to his room about midnight, but was found dead the next morning.

The late Mr. Hermeston was born on a farm in Normanby Township, near Mount Forest, sixty-four years ago last December. After finishing his schooling he learned the tinsmithing and plumbing trade in Mount Forest and afterward worked at this trade in Markdale, Prescott and Lindsay. Later he moved to Walkerton and with his brother-in-law, James Nichol, purchased a plumbing and tinsmithing business which he controlled successfully for over a quarter of a century.

Taking a keen interest in municipal affairs, he served for a couple of years as Councillor and for two terms as Reeve of the town. On the inauguration of the Walkerton Hydro-Electric Commission in 1931 Mr. Hermeston was elected a member, where he has served continually until his death.

He was a man of forceful personality and decided views. He was highly regarded for his outspoken sincerity of purpose and was considered one of the most dependable public servants the town has ever had. His sudden demise is deeply regretted.

We extend our sympathy in their loss to his widow and son, and also to his two brothers and three sisters who survive him.

Simcoe Public Utilities Doing a Good Lighting Job

Living Room with ordinary lighting.

Living Room equipped with modern lighting units.

THE Simcoe Public Utilities Commission is demonstrating very forcibly what can be done to promote Better Light for Better Sight. Since early last Fall they have been actively engaged in the many activities which this movement entails. They employed a Hydro-trained Home Lighting Expert and put her to work, and an excellent job is being done by enlisting the help of dealers in the sale and demonstration of modern lighting equipment. Various types of Women's clubs are being interested in the Home Lighting Story and many prospects for demonstrations in the home have been produced by these media.

The good work which is being done in Simcoe is spreading to the neighbouring municipalities. Inquiries are being received from Waterford, Caledonia, Hagersville, Port Dover, Port Rowan and others for the services of a Home Lighting Expert.

Remember, Simcoe has only a population of 5,174, among whom there are 1,207 domestic consumers. They are showing the way to other Hydro municipalities in this new field.

To help put the story across, two model living-rooms have been erected in the Town Hall, and a lively interest is being displayed in these exhibits. The Better Light—Better Sight movement has gained ground rapidly, but it requires the stimulus of the Local Utility to make a success of it. Follow Simcoe's example of aggressiveness.

Underground Distribution of Electric Power

By R. E. Jones, Distribution Section, Electrical Engineering Department, H.E.P.C. of Ontario

(Presented to Association of Municipal Electrical Utilities, Toronto, January 30, 1936.)

MUCH has been written about the construction of overhead lines and little about underground. Possibly one reason is that every time we go out we see the former but the latter being out of sight is forgotten.

HISTORICAL

Before we consider the various forms of underground now in use we will review some of the early types of construction.

Underground conductors were first used for telegraph and similar systems. In 1812 a submarine mine in Russia was exploded by electricity using a conductor insulated with strips of india-rubber. Four years later a telegraph line of 500 feet was installed with an insulation of glass tubes sealed with wax. In 1842 Samuel Morse laid a telegraph cable in New York Harbour, covering the copper wire with pitch, tar and rubber as it was paid out of the boat. Two years later Morse laid several miles of telegraph cable between Washington and Baltimore but it was abandoned due to defective insulation. Four No. 16 wires covered with cotton and shellac were drawn into a lead pipe and the whole passed between rollers. Between 1847 and 1850, 3,000 miles of wire were laid underground in Germany using a gutta-percha covering. This insulation deteriorated rapidly and the lines were abandoned. About the same time in London a system was installed using several No. 16 wires insulated with gutta-percha drawn into 9-foot lengths of 3- or 4-inch pipe. The ends were sealed with lead and the end of each run terminated in a test-post above the pavement. This system was still in operation in 1875. In 1853 in England other lines were installed, one having gutta-percha insulated wires drawn into iron and earthenware pipes. The other one had gutta-percha covered wires laid in tarred jute in a wooden trough. In 1863 vulcanized rubber was first used for cable insulation.

When Edison started his Pearl Street Station in 1882 the downtown streets in New York were a maze of overhead wires—telegraph, telephone, ticker and fire alarm, and series arc circuits. For this reason he decided that his distribution system must be suitable for installation either above or below ground.

The so-called Edison Tube System had two or three copper rods covered with jute drawn into a 20-foot length of iron pipe. The latter was then filled with a bituminous compound. These pipes were laid in a trench and spliced with split egg-shaped castings filled with compound. At intersec-

tions circular fuse boxes were sunk in the ground. This system was built for 110/220 volts. Some of it is in service to-day in several large cities.

Soon after Edison built his system in New York the authorities in that and some other large cities passed laws prohibiting the use of overhead wires after a certain date. The tangle of overhead wires, many of which belonged to defunct companies, necessitated some such action.

As the Edison underground system was not suitable for the series arc circuits which operated at about 2,000 volts, experimental installations were made of different cables. The best type seemed to be the rubber insulated cable with a lead sheath.

In 1890 Ferranti in England built a paper insulated cable for operation at 10,000 volts, some of it still being in operation 34 years later. Two concentric conductors were insulated with wide strips of paper applied helically and saturated with a rosin base oil. The conductors were then forced into 20-foot lengths of lead pipe. This cable was not flexible and was buried directly in the ground. A short time later a flexible paper cable was developed using narrow paper strips similar to the present-day practice.

INSTALLATION

There are three methods of installing underground cable—ducts, troughs, and buried.

Early "pulled in" systems used iron pipe. This was followed by pump logs, both rough and then trimmed, the latter with creosote treatment.

In 1891 single tile duct was first used, followed 4 years later by multiple tile. In 1893 fibre duct was developed.

Tile duct is manufactured by pressing a clay mixture through a die to give the required shape. The tile is then fired and glazed. The standard lengths are 18 inches with bore of 3¼ or 4¼ inches. It is made with a single duct, both round and square bore, and two, three, four, six and nine duct with square bores.

Tile duct is laid in a trench commonly with a 3 inch envelope of concrete.

Fibre conduit is generally manufactured by felting wood pulp on a mandrel to the required thickness and allowing it to dry. It is then impregnated with a waterproof compound and the ends are turned on a lathe to give a final length of 5 feet. It has the texture of hard rubber and is impervious to water and many chemicals. It is installed with a concrete envelope in a similar manner to the tile duct.

An advantage gained by the use of fibre duct is that several layers may be built at one time using concrete spacers and the concrete poured for the whole at one time. With tile duct one layer must be laid at a time, with time to set before the next one is placed.

Jointed rods are pushed through the completed duct to pull in a rope or cable to draw the cable into place.

Duct lines are terminated in manholes at main street intersections and at intermediate points where cross-street spacing exceeds 500 feet. A manhole may be of brick or of concrete and has a reinforced roof using old rails or I beams for brick or reinforcing rods for concrete. A casting is placed on the top to hold a

cover flush with the pavement. Round covers are preferable to square as the former cannot fall into the manhole. For low voltage secondary circuits a smaller hole known as a "hand-hole" may be used, frequently being installed in the sidewalk.

Another type of duct line in use to a limited extent is known as the Monolithic. It consists of a continuous block of concrete between manholes, concrete being poured into a machine which forms the duct as it progresses. For short lengths and for approaches to manholes with this duct a different process is used. A thick-walled rubber hose of the required diameter is laid in position and the concrete is poured over it. After setting the hose is pulled out, the tension on the hose causing it to contract and thus come away from the concrete.

In Europe cables are frequently installed in troughs. A wooden or tile trough is placed in the trench and after laying the cable in it the whole is covered with compound.

Another system in common use in Europe and to some extent in America is Buried Cable.

Either armoured or plain sheath cable is buried from 1½ to 2 feet in the soil. If the cable is not armoured a protective creosoted plank may be placed over it. Buried cable may be dropped by hand into the excavated trench or it may be fed through a special plow into the hole from a travelling cable reel. Where the cable passes beneath paved roads it is advisable to install a pipe to facilitate replacement. The breaking of the pavement may be either eliminated or reduced by the use of a pipe-jack. A point is attached to the end of a length of pipe and a jack forces it through the soil, the jack is removed and another piece of pipe is added and the process is repeated. It is possible to install a pipe by this method for distances up to 200 feet.

The buried cable is cheaper to install due to the absence of expensive duct lines. Also it has greater capacity due to the more rapid dissipation of heat into the surrounding soil. It is seldom that a buried cable is damaged from external causes and when this does happen the location of the fault is usually discovered readily. However, if buried cable must be replaced it is a somewhat costly operation to dig up a lot of pavement.

CABLES

Cables are usually either single or multiple conductor, the latter generally have three separate conductors, round in section for the small sizes and sector shaped for the large ones. In Europe multi-conductor cable often has a separate sheath around each conductor with a jute covering overall, with a saving in lead and weight. Concentric cable also is frequently used.

There are three general types of cable insulation in use to-day.

Varnished cambric is used to a limited extent, mainly in stations. It is non-hygroscopic and has high insulating value but its cost is higher than for either rubber or paper. An overall covering of braid is generally used.

Rubber insulation is not affected by moisture but unless one of the newer rubber compounds is used

there is danger of rapid deterioration due to corona. A lead sheath may be used, or a braid covering. Sometimes a metallic tape or braid is used beneath the braid, particularly with the higher voltages.

The non-metallic sheath cable has certain advantages over the lead sheath type. It is not attacked by soil chemicals, there is no trouble from electrolysis, a wiped lead joint is not required, power losses on single conductor cables are lower, and the first cost is less. With a damaged sheath there is greater resistance to moisture than with a lead and paper cable and there is no arcing to ground when a failure occurs in a non-metallic duct, and it is more flexible. It is commonly made in voltages up to 7,500 to ground.

Paper probably provides the best insulation for cables but it must be sealed from all moisture, lead being the usual covering. Both manilla and well calendered wood pulp paper are used, the latter being stronger both electrically and mechanically. The paper is generally impregnated with rosin oil.

For high voltages such as 132 kv. the conductor is hollow and is filled with oil maintained under pressure by means of pressure tanks at frequent points along the line.

Cables for operation at over 20 kv. are generally shielded. A grounded metal sheath is applied over each conductor and the overall belt insulation is omitted. The electric stress is thus removed from the filler spaces and the cable has also better heat radiating properties.

The lower voltage cable with two or more conductors has a belt of insulation around the two conductors as well as the insulation around the individual conductors. The space between the conductors beneath the belt is filled with jute or similar material.

Conductors are soft drawn copper, stranded for all but the smallest sizes.

The sheath consists of a continuous layer of lead or an alloy of lead with antimony or tin. The lead is placed in a hydraulic press and is extruded around the cable as it passes through the press, the lead being in a solid state.

In a recent development for high voltage, the cable is enclosed in a pipe and a pressure of nitrogen in the neighbourhood of 200 lb. is maintained. Another type has a reinforced sheath with the nitrogen under pressure in ducts beneath the sheath.

Paper insulated cable requires suitable terminals, generally called potheads, where connection is made to open wiring. The body is of metal and porcelain with one or more terminals with means of sealing the lead sheath to the metal part. The body is filled with compound.

Splices in this type of cable are generally made with a wiped lead sleeve overall, although a form of splicing box is used with stuffing glands at the ends. In either type the joint is filled with compound.

Networks

In the densely loaded areas of some of our larger cities network systems are used. The secondary cables are tied together into a network with feeds at numerous points. In event of fault on one of these cables there is sufficient capacity in the system to burn the trouble clear. This requires a cable which will withstand heavy

overloads. Consideration must also be given to the gases liberated by the combustion of such a cable at a fault. Insulation in use is rubber, paper, and asbestos, lead being necessary for the paper and the asbestos cables.

Residential Areas

For distribution in residential areas and in the business sections of smaller municipalities various systems of secondary mains are in use. The load is not great enough to warrant a "network" or even "banking" of transformers so individual buses must be planned.

There may be a sidewalk duct line with frequent hand holes and laterals feeding one or more consumers. Or the duct may be omitted and junction boxes patterned after the Edison splice box may be used.

For the more scattered services found in a residential area a secondary cable without lead may be used, either pulled into a cheap duct such as creosoted "pump-log" without concrete envelope, or buried directly in the soil. Short sections of cable may be terminated in junction boxes, perhaps of concrete, where service laterals may be attached. One such system has been installed with concrete boxes large enough to contain four meters and located on the back lot line.

Transformers on an underground system may be installed in any one of several ways. On a large system it is usual to build large underground vaults to contain the transformers and the protective equipment. For areas with medium or light loading the transformers may be buried directly in the soil providing a waterproof case is used. Another method is to place the transformer on a short pole at a suitable location and to loop the primary and secondary cables up this pole. One utility is experimenting with the placing of small transformers in a 30-inch concrete sewer pipe laid on end with a very heavy concrete cover.

Where fusing is required on underground cables it is usually limited to secondary voltages. If a primary circuit must be protected an oil switch should be installed in a manhole. If this is not desirable the cables may be looped up a short pole and weatherproof type fuse-switches used. Where the secondary cable is installed in ducts waterproof porcelain fuse blocks are installed in the manhole.

A system for fusing various voltages which is commonly used in Europe but is practically unknown here is the fuse-pillar or kiosk. A box of iron or steel from 2 to 5 feet in height is installed on the sidewalk near the curb or at some other suitable location. It contains fuses, switches, and perhaps even a transformer and may be securely locked.

Rural

In 1921 the installation of underground cable for the supplying of rural consumers was commenced in Ontario.

The area in which these installations were made is north and west of Niagara Falls and is some 40 miles in length. The country is well settled, mostly with fruit farms and small hamlets. While the roads are reasonably straight there is an abundance of heavy maple and other shade trees. While considerable overhead line had been erected in this

area, the construction was frequently expensive and there was increasing difficulty in obtaining permission to trim trees.

There are now about 200 miles of rural underground circuit in use, most of it having been installed in the first two years.

The system of distribution in use in this area is 4000-2300 volts with common primary and secondary neutral grounded at each transformer.

The original cable was single conductor No. 6 B & S 7-strand copper with an insulation of 3/32 inch of 30 per cent. para rubber covered with a rubber-filled tape and 1/16 inch of lead overall. The lead sheath was used as the return circuit. The test was 7 kv. for 5 minutes at the factory.

Due to trouble with the rubber insulation later installations were made with a paper insulated cable as it was possible to get a more uniform product with the latter. The paper insulation had a thickness of .14 inch and passed a factory test of 12.5 kv. for 5 minutes. Less than one quarter of the cable installed was paper insulated.

The cable was buried without a coverboard to a depth of 18 inches. In the case of a three-phase circuit, of which there was a small amount, the three single cables were separated 4 inches. Excavation was by means of two cuts with a plow, a cut with a road-scraper, and then the plow followed by the scraper. Cable was fed into the trench by hand and the backfilling done with the scraper. At each transformer location the cable was looped up a 25-foot pole, terminating from each direction in disconnecting potheads. The transformer cutout was connected to the jumper between the potheads and the other side of the transformer primary was attached to the cable sheaths which were also bonded together.

The labour cost per foot for installing the cable with 30-cent labour was two cents for excavation, ½ cent for laying the cable, and 1 cent for backfilling.

This underground system has given very good service. Since removing some defective rubber cable little trouble has been experienced and with the paper insulation no trouble has developed with the cable except from external causes.

When first installed the overhead system standard at that time was 160-foot span with No. 6 copper. The rubber insulated cable cost about 9 cents a foot at first and for single phase could be installed at a lower cost than overhead. Since then, however, the cost of the overhead line has been reduced about 20 per cent. by more economical forms of construction and the cost of the paper cable is higher. For a three-phase circuit the installation cost of an underground line is higher than for overhead. Thus while underground construction for rural cannot compete with overhead on a first cost basis for average conditions there are places where it is economical to install it, particularly as the maintenance cost of underground is lower.

Consideration must be given to the saving by the elimination of arresters and the absence of transformer and meter burnouts from lightning. Another advantage is the freedom from sleet troubles. In a bad ice storm one district with 277 miles of rural

primary had only two miles in service; they were underground with the balance of 275 miles overhead.

OVERHEAD CABLE

A comparatively new use of insulated conductor is the erection of cable on poles.

Perhaps a new sub-station is required remote from an overhead high voltage line, the extension of which is not feasible. If the exact economic location for a permanent sub-station cannot be determined at the time the use of a temporary underground cable would be too costly. A large lead-covered cable suspended on a messenger may be erected on existing poles at a reasonable cost and may be moved at a later date.

The smaller sizes of cable both lead and non-metallic sheath are used for primary distribution, the former requiring a messenger may be erected on existing poles at a reasonable cost and may be moved at a later date.

The smaller sizes of cable both lead and non-metallic sheath are used for primary distribution, the former requiring a messenger. The latter may be self-supporting or be on a messenger. With the lead-sheath cable some trouble has been experienced with vibration breaks in the sheath.

With the heavy trees on a street excessive trimming may be avoided by the use of an overhead cable and if it has a non-metallic sheath taps may be made without much labour.

One large rural system is in service with non-metallic sheath cable, using the messenger cable for the common primary and secondary neutral. Two frequent causes of service interruption are thus eliminated; trees and lightning. As is general practice with non-leaded cables operating at over 3,000 volts there is a metallic shield between the rubber insulation and the outer braid.

OPERATION

Cable failures are not a serious hazard as shown by the report of the Edison Electrical Institute for 1933. On distribution cables there was an average of 4.4 failures per 100 miles per year. Street lighting cables were highest with 12.8 per 100 miles, primary 3.9, secondary networks .9 and other secondary .6.

With impregnated paper the rate was 4.3 and for varnished cambric and rubber 3.6.

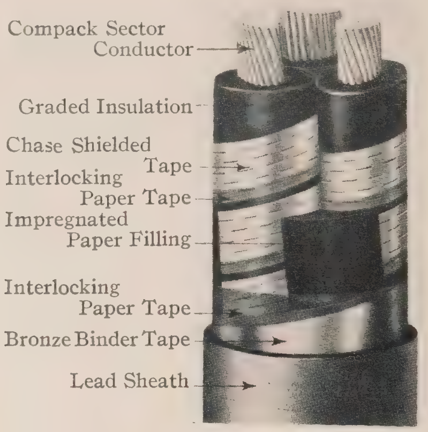
These data were based on the operation of 51,000 miles of cable of which 17,000 miles was paper insulated and 25,000 varnished cambric and rubber, 97.1 per cent. of this cable was in ducts, 2.3 per cent. lead sheath buried, and .4 per cent. non-metallic sheath buried.

CONCLUSION

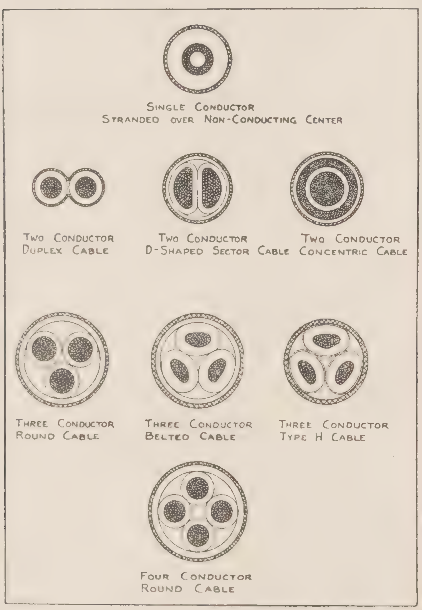
While the first cost of underground construction is higher than for overhead the former has advantages that tend to reduce this difference in cost when considered over a period of years.

Poles and crossarms deteriorate more rapidly than cable, sleet storms and lightning are two hazards to overhead lines not encountered with underground, trees must be constantly trimmed to maintain service with overhead wires, and with a fire these wires are a hazard to the firemen. Finally, the present maze of overhead wires and poles do not add to the beauty of our streets particularly where the road is laid out in curves where many guys must be installed.

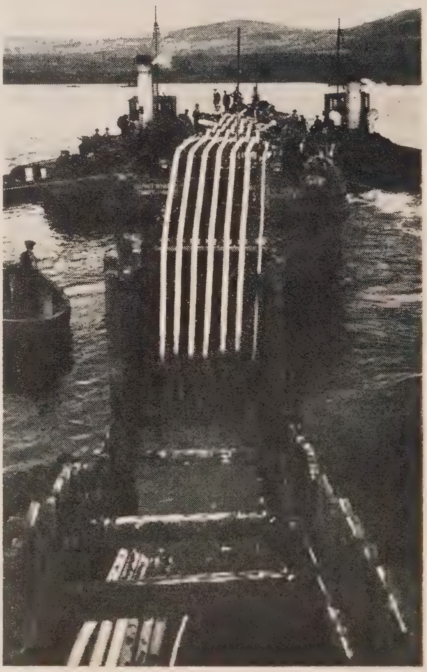
Run of Single Ducts for Power Cables.



Modern Shielded Cable.

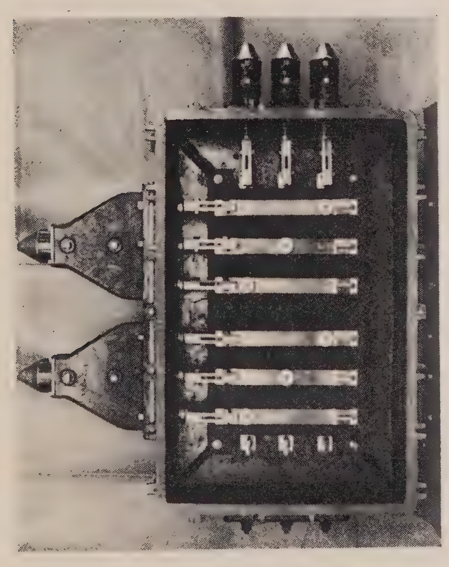


Cross sections of various Lead Covered Cables.

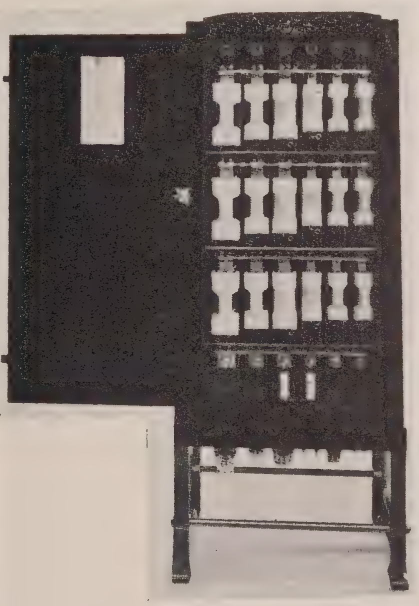


Laying Cables—Belfast Harbor (Photo, W. T. Henley's Telegraph Works Co.).

Fuse Pillar Box, England. (Photo, W. T. Henley's Telegraph Works Co.).



Manhole Junction Box, 115/230 volts.



Fuse Pillar Box, interior (W. T. Henley's Telegraph Works Co.).

The Present Trend in Service Entrance Practice

By C. E. Schwenger, Distribution Engineer, Toronto Hydro-Electric System.

(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1936.)

THE purpose of this paper is to place before this meeting data in connection with developments in overhead service and service entrance practice, which have become very popular in some localities—particularly across the line.

There have come into the market during recent years several types of service cable which are intended to replace with one cable the open type conductors now used for overhead service wire connections. These service cables are intended primarily to improve the appearance of overhead line connections between the service pole and the building. The idea is not new as service cable has been used by some concerns for many years.

These service cables are usually weatherproof rubber covered conductors twisted together without a containing covering and are carried from the service pole as far as the standpipe to which they are connected in the same manner as the open type service wires.

More recent developments of these simple service cables make use of an enclosing weatherproof braid covering and, where three wire service using grounded neutral conductor is to be connected to the standpipe, a bare neutral conductor has been incorporated in the cable. Such cables are run along the face of buildings, connected to service standpipes, without the use of service brackets, and greatly improve the appearance of the installation.

A further development is to replace the ordinary rigid conduit standpipe with the same material as the service carrying such a cable from the service pole to and along the building, terminating same inside the building at the main service switch.

It must be noted that service cable has not yet been approved in Ontario as a substitute for the rigid conduit standpipe, but the approval of some type of service cable will, no doubt, take place when the demand for such use of cable grows. This eliminates the usual standpipe and condulet; also eliminates service brackets, greatly improving the appearance of such an installation.

This construction lends itself readily to the installation of the new sequence type of metering; which is also a very definite present day trend.

There are several types of service cable. A few are shown in cross section in the cuts, herewith. These are intended for three-wire service and consist of two line conductors, rubber insulated with a bare neutral copper conductor, enclosed with them in a braided weatherproof covering.

Type 3, (Fig. 1), is the more common type but Type 1 and Type 2 are

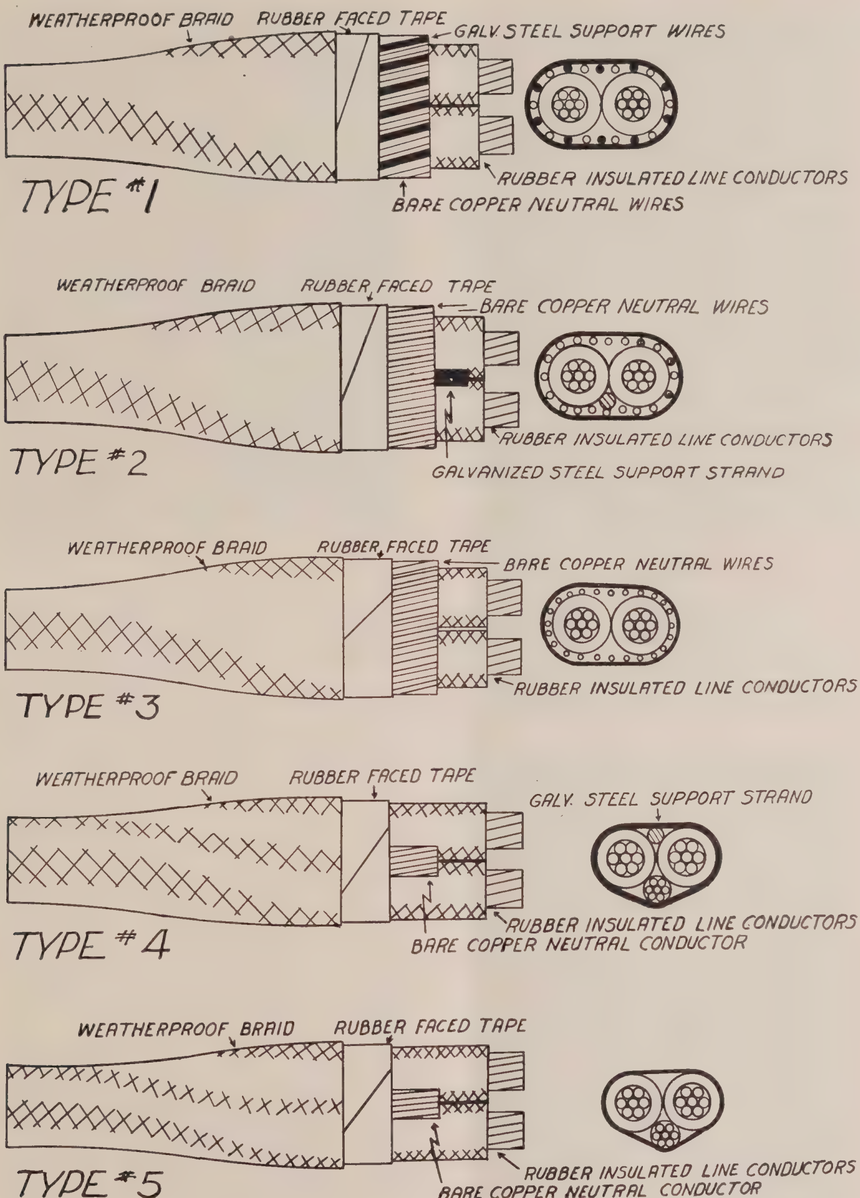


Fig. 1

very similar, except that the neutral copper conductor has added to it sufficient steel stranded conductors intended to take the strain of supporting the service cable. This latter construction is somewhat new and several experimental installations have been made. Type 4 also has a galvanized

Fig. 2

Fig. 4

steel support strand intended to take the strain. Type 5 has no special supporting steel strand but is intended to be self-supporting. Where long spans are encountered the steel supporting strand should be a decided advantage in the service construction but tests are still under way.

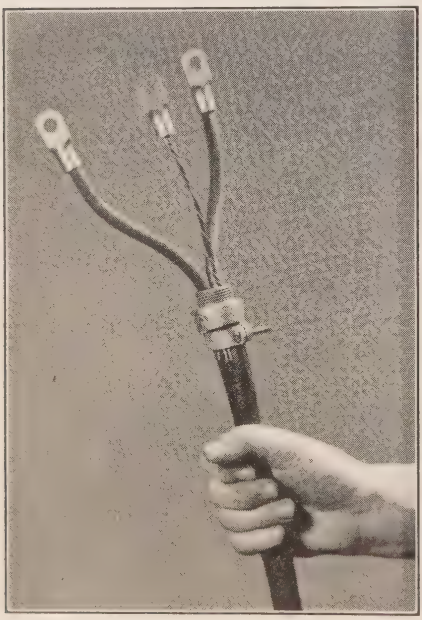


Fig. 3

A service cable installation is shown in Figs. 5, 6, and 7. This cable consists of two No. 6 rubber covered conductors and an overall layer of No. 16 copper wires for the neutral and No. 14 steel galvanized strand, arranged as shown on drawing for Type 1 cable. The absence of service brackets and condulets will be noted. The method of terminating this type of cable at the service box is not a very difficult matter and one method is illustrated in Figs. 2, 3 and 4. This clearly shows details.

In this case the steel reinforcing strands are bent back under the clamp and the bare copper neutral strand bunched together may be carried forward into the box.

Where outdoor type of meter ahead

Fig .5

of main service switch is desired on such a service installation it is a simple matter to cut the cable and make service installation at any point required.

The method of dead ending and supporting the cable of this type at pole or building may be accomplished in a number of ways, but one of the newer and better arrangements is by the use of Kellems Service Grip, which is really a small counterpart of the well known Universal Grip, so commonly used for pulling lead covered cables into underground conduit sys-

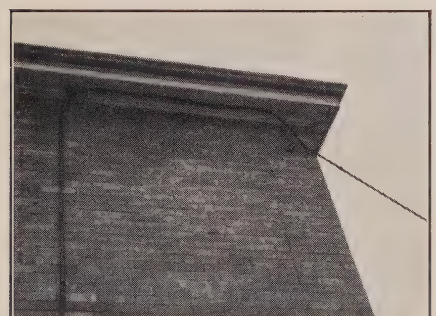


Fig. 6

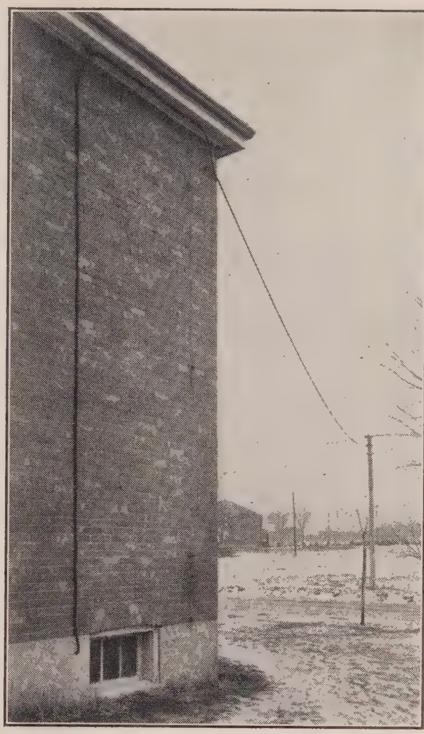


Fig. 7

tems. Such a grip dead ends the service cable without breaking into or damaging the weatherproof covering.

As to costs, there is no gain where the cable is intended to supersede open service wires only and run only between pole and usual conduit standpipe, however, if the standpipe is also superseded by this cable a substantial saving is effected. The advantages which would result through the use of service cable from the pole to service box, over the present open service wires and rigid conduit standpipe construction, may be summarized as follows:—

1. Better appearance.
2. More economical on account of

standpipe and brackets being eliminated.
3. Reduction of joints in conductors.
4. Less tree and radio interference.
5. Reduced trouble hazards caused by swaying wires.
6. Better clearance in limited spaces.
7. Greater ease of installation for outside metering, if, and when required.

In regard to costs, there is a saving of approximately 25 per cent. on the initial cost of installing the service cable, in place of the usual open service wires and rigid standpipe.

Some of the points on which discussion is invited are as follows:—

1. In regard to the better appearance which results through the use of service cable, what practice should be followed regarding the existing open type service connections from the same pole as that from which service cables may be run? The full benefit of better appearance will not be obtained unless all the services radiating from the pole are of the service cable type. A combination of two types of service does not accomplish the same results which might be obtained by changing all the services.

It is a question whether the expense in changing over the existing open service wires to the new type is justified except in special locations, such as high grade residential districts and the like.

2. In regard to the elimination of standpipe and brackets bringing about a greater economy, there is a saving of 25 per cent. on the initial installation cost but against this must be considered the position which the electrical contractor might take.

There is also the question of whether the new service cable, when installed in place of the usual standpipe, is sufficiently tamper-proof.

There is also to be considered the relative life of such a service cable entrance over the rigid conduit standpipe.

3. Reduction of joints in conductors.

The joints eliminated are the three at the standpipe head, and these are often made with solderless connectors. These are eliminated but so is the flexibility of connecting or disconnecting of service for one reason or another. The point of disconnection on the new construction is transferred from the building to the pole.

Another point which needs attention is that overhead services as at present run to the building and are very often tapped at the building to supply the adjacent building; thus eliminating the necessity of running two services from the pole. This flexibility of supply is more or less lost in the case of service cables which are not adaptable to being readily tapped for such connections.

In the case of the present open wire services smaller weatherproof conductors are used than the rubber covered conductors installed within the standpipe. This is on account of the difference in the current carrying capacity of conductors having weather-proof or rubber insulation.

In the case of the service cable the larger conductor would be used from the pole to the building, but this has

some compensating advantage in providing better voltage regulation to the consumer due to the smaller voltage drop in the service wires.

It would appear that the installation of service cable wire carried to the service box would have to be done by one authority and that would probably be the supply authority and not the contractor. This is due to the fact that the cable would be in one length from the supply authority's pole to the service box and could best be worked upon by them, as the final connection at the pole, in any case, would have to be made by the supply authority. The electrical contractor might have an objection to such an arrangement but the installation of the cheap service entrance, such as that obtainable with the service cable, might be the means of obtaining business for the wiring contractor; such as the wiring up of new ranges, etc., which would not otherwise result if the consumer were faced with a heavy expenditure for the usual standpipe.

4. Better clearance in limited spaces.

With open service wires at present difficulty is experienced in obtaining proper clearance from fire escapes, large electric signs, trees, open porches, and the like. The service cable is a very good solution of the difficulty because it can be so installed, on account of its grounded conductor, on the outside so that it can be within reach of the users and present no danger to them. This is an important application of the service cable.

A few of the points in connection with this development have been presented and it is hoped that a thorough discussion will result in order to bring out points not covered.

The advantage of better appearance of overhead construction, which is a result of the use of service cable is described as becoming more important. In more districts there is a desire for the elimination of poles on the streets due to unsightly appearance of the wires and their apparatus, such as transformers attached to them. More sightly construction of overhead lines and transformer installations are being made and the development of the more sightly service connection is a step in the same direction.

In Toronto, in residential districts, at present primary extensions are made of armoured conductors which eliminates the usual cross arm construction which is unsightly, the wire spacing is smaller and such primary extensions are also made on short concrete poles. The transformers, which are the greatest source of complaint as to appearance, are being installed on concrete poles which brings about a great improvement in appearance.

The service cable, as pointed out before, is another step in the same direction and will produce a rather big improvement in appearance.

Metal Clad Switchgear

By L. B. Chubbuck, Switchboard Engineer, Canadian Westinghouse Company, Limited, Hamilton.

(Presented to Association of Municipal Electrical Utilities at Toronto, January 30, 1936.)

METAL clad switchgear is rapidly becoming the standard for new equipment in Canada. While the cost is somewhat higher than for the so-called open type switchboard the advantages readily warrant this extra expense.

The advantages of metal clad switchgear can be briefly stated as follows:

Safety

All live parts are completely enclosed in grounded metal casing and all operations are fully interlocked to prevent possibly serious mistakes in operation.

Compactness

Metal clad switching equipment is generally much more compact than the corresponding open, or masonry cell construction. In many cases the instruments, etc., are mounted directly on the metal clad structure.

Service

Due to the high insulation and substantial mechanical construction usually provided, a minimum of trouble is experienced in service. In gum filled metal clad gear particularly, the buses, etc., are immersed in highly insulating gum and are free from dust, moisture, including condensation, smoke, vermin, insects, etc.

Non-brittle micarta supports under gum (which acts as a buffer) give a high mechanical factor of safety against short circuit stresses.

Maintenance

The maintenance is simplified for the above reasons, and also assisted where provision is made for withdrawing a breaker for inspection.

Installation

Metal clad switchgear is factory built and shipped completely wired. The installation time and expense is thus a minimum, particularly where the instruments, etc., are mounted directly on the metal clad gear.

TYPES OF METAL CLAD SWITCHGEAR

The so-called "*Cubical Type*" is generally open type gear simply boxed in, frequently in a metal enclosure. This gives safety from accidental contact but does not provide many important advantages included in the following gear.

Truck Type Switchgear comprises a removable panel and breaker equipment, which plugs into a stationary air insulated bus and feeder, etc., compartment. The panels and compartments are now usually of steel. The truck is fully interlocked and may be withdrawn for inspection of breaker contacts, etc. The trucks are, however, usually heavy and ponderous and there is often trouble in alignment and interchangeability. In

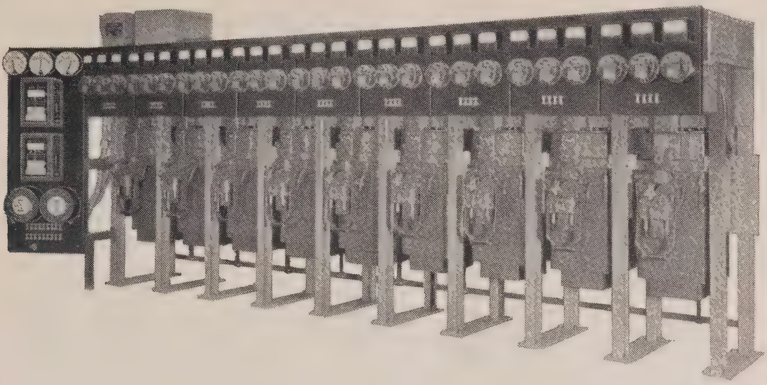


Fig. 1—Brantford Hydro-Electric System—metal clad (type BK) switchgear.

case of several different capacities, etc., of panels in the same structure the cost of spare trucks is high.

Horizontal Draw Out metal clad gum filled switchgear comprises a horizontally removable oil circuit breaker unit and a stationary bus bar unit. Connections between the two units is made by insulated plug contacts, the live bus contacts being enclosed by automatic shutters as the breaker unit is withdrawn. All operations are fully interlocked.

Vertical Lift metal clad switchgear comprises an air, gum or oil insulated bus structure and a breaker unit that moves vertically to plug into the bus structure. This, as compared with the "horizontal draw out" type permits the use of standard oil circuit breakers with their short vertical bushings. The vertical lift design also takes less floor space and is more adaptable to outdoor operation.

Bus Insulation

The bus compartments of metal clad switchgear in different types of construction may be air filled, gum filled or oil filled. For lower voltages

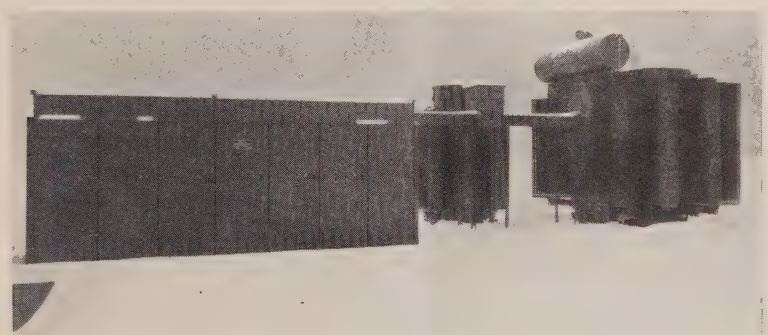


Fig. 2—Ottawa Electric Co.—outdoor (type B-20) metal clad switchgear with induction regulator and transformer.

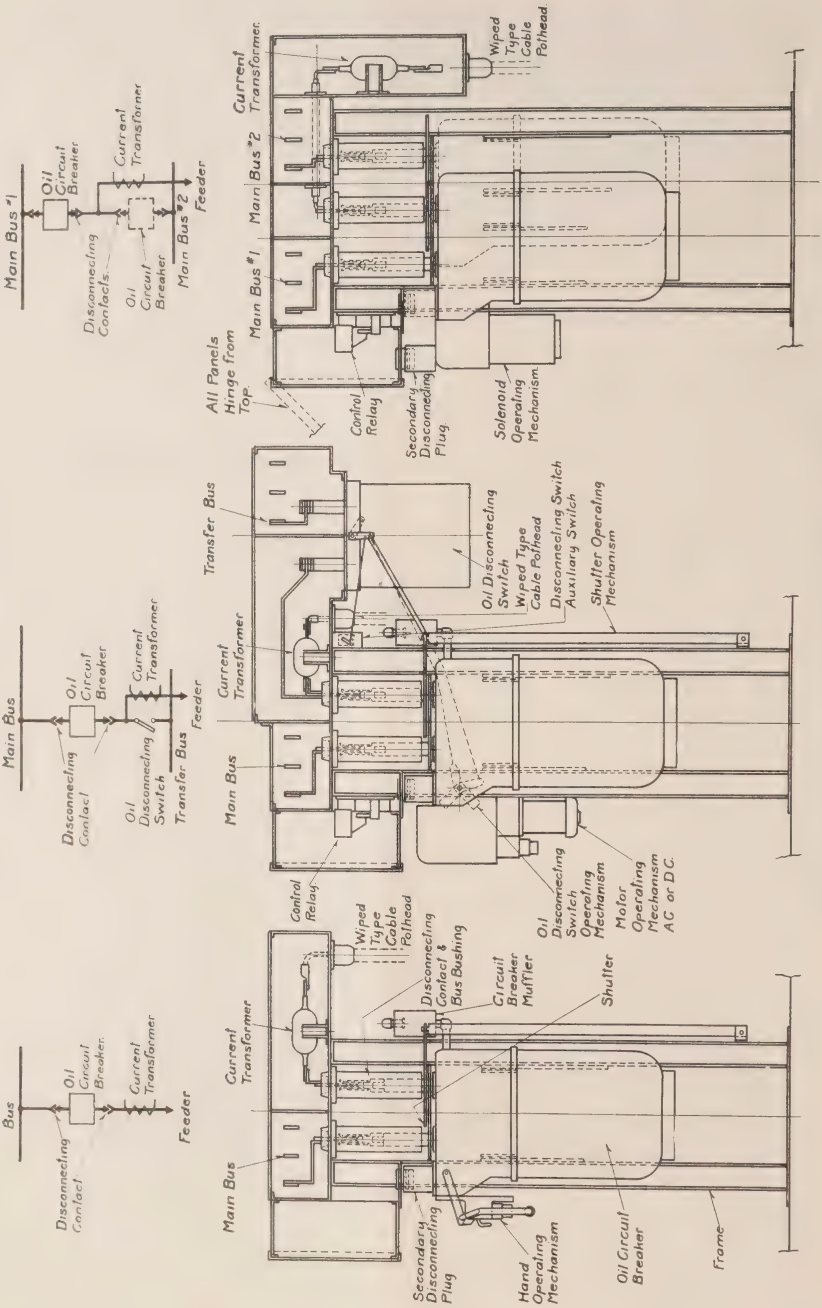


Fig. 3—Typical metal clad structure sections.

Fig. 4—Chats Falls Generating Station, 15 kv. metal clad switching structures for generators 2 to 9, station service, also oil disconnect and gum-filled bus for frequency changer set.

and where reasonable spacing or micarta insulation is provided on the buses air is often used. For 15,000 volts and upwards gum or oil is recommended. In switchgear that may be required to be frequently moved or altered, air is sometimes used for 15,000 volt service but heavy insulation should be furnished over the buses and ample spacing to prevent ionization. Gum or oil filling avoids air pockets and provides a more compact construction and much higher insulation test. Oil or gum sealing also prevents condensation, dust, etc., over the insulation.

A special gum of rubber consistency is used that will not crack at low temperatures and that will not be come fluid under outdoor summer conditions. This gum is of high dielectric strength, approximately 100 kv. for an inch. There is no record of any failure of this gum in service. In case of switchgear alteration or extension, the gum may be readily removed by a heated knife. Petrolatum may be used in current transformer compartments.

Standard transformer oil provides excellent insulation but extreme care and expense is involved to avoid leaks, particularly in long and complicated structures.

Construction Details

As most details in metal clad switchgear are concealed and not available for inspection, a large factor of safety should be provided both electrically and mechanically.

All joints should be both bolted and sweated. No brittle insulation should be used.

Bus bushings, for making contact between the breaker and bus, should be as simple as possible and preferably use a plain plate or rod for the stationary contact. The contact fingers, shunts, etc., should be mounted on the breaker bushing and thus be available for ready inspection.

The oil circuit breaker, to conform with metal clad switchgear, should be of the latest iron clad, oil tight construction, and fully tested to prove its interrupting ability. The safety value of the best metal clad switchgear is lost if equipped with untested dangerous oil circuit breakers.

The current transformers may be mounted either in compartments or as bushing transformers around the bus bushing contacts, or inside the breakers.

The voltage transformers with their fuses and resistors are usually mounted in separate air boxes for the lower voltages and under oil in a tank for 15 kv. and above. These assemblies are preferably arranged to plug into their circuit for easy removal.

In vertical lift switchgear the oil circuit breaker is usually handled on a truck. This truck is used for elevating the breaker into bus contact, for transferring the breaker to another cell, or simply drawing the breaker out of the cell for inspection, lowering the tank, etc.

An individual lifting mechanism for every cell is sometimes used. Unless the cell is large, however, there is insufficient room for inspection in the cell and a separate truck must be used to take the breaker out of the cell.

Bus Arrangement

Due to the high factor of safety provided in the buses of metal clad switchgear, particularly if gum or oil filled, no maintenance is anticipated, and a simple *single bus* arrangement is often sufficient.

Where the service is such that provision must be made for inspecting any breaker without interrupting service on that circuit even momentarily, a Transfer Bus arrangement is recommended. The necessary connections are made by iron clad, non-automatic oil disconnecting switches. Such oil switches can also be used to advantage in ring bus and other arrangements.

For a standard "double bus" arrangement provision is ordinarily made for moving any breaker by truck or carriage from one bus to the other bus. This means an interruption in the circuit for some seconds. If no interruption can be permitted, the transfer can best be made by an oil disconnecting switch.

Conclusion

Metal clad switchgear has important advantages and this type of switchgear has had an enviable service record. There are numerous present installations of open type gear which are outgrown and unsafe. In many cases it is possible to replace present equipment with metal clad equipment of much larger capacity in the same or less room. In other cases it may be advisable to install outdoor metal clad switchgear. In any case, the installation of this type of switchgear relieves the owner of responsibility, in that the safest and best gear obtainable has been provided.

Collections

By J. F. Cook, Windsor Hydro-Electric System

(Presented to Accounting Session of the Association of Municipal Electrical Utilities at Toronto, January 30, 1936.)

HYDRO Systems today are vitally interested in the sale of power, with the object of increasing load and revenue. It seems only fitting that in view of the importance of collecting accounts, the policy of the Collection Department should be built up to meet the requirements of the sales policy, and be one that will operate efficiently and in a business-like manner, and maintain the good will of each and every consumer. Otherwise, we are in the same position as a retailer attempting a sales promotion, with no thought or preparation for collection of the account. It must be remembered that regardless of whether the sale is power or merchandise, it is impossible to carry on business by merely transferring the sales to accounts receivable, as the profit can only be figured when every cent of the charge to the customer has been collected. It is all very well to show a book figure in statements representing accounts receivable, but are they worth one hundred cents on the dollar?

In my opinion, if every municipality were obliged to make a survey of its accounts receivable during each current year, and write off all those that were absolutely uncollectible for the time being, it would have a tendency to show greater care in supervision of the collections, and yet, to obtain the true picture of our worth and standing, this must be taken into consideration. It is not suggested that these accounts be forgotten, but on the contrary, should be given special attention, and a definite arrangement made with the debtor to retire the amount owing by way of regular instalments. These payments can be recredited to your bad debt reserve. I might say that in recent years, we have followed this practice with the result that our accounts are cleared of long outstanding arrears, and at the end of October, 1935, our arrears were low enough that the reserve set up for bad and doubtful accounts was sufficient for a one hundred per cent. coverage.

During the years of depression, many consumers who have always had good records, have met with financial difficulties, and while we have every sympathy for such cases, we must not forget our duty to the consumer who pays his account when due, and who is at all times the backbone of the System. We, as employees of the Hydro Commissions, are greatly in the position of trustees of public funds, in which every consumer is interested, and it is up to us to formulate a collection policy which will meet the needs at the lowest possible cost. There is no end to the value of having a set routine for collection of accounts, so that the customer knows exactly what to expect, and we should at all times, avoid the policy of a threat

or any action for which we could be criticized. In fairness to the good customer, we cannot be lax with the delinquent one, and when the service is due for disconnection, action should be taken without delay.

We in the Border Cities, I believe, are faced with probably more difficulties than farther inland, as the population is not as settled, and our employment is more or less seasonable. Our collection policy has been strict, and firm, and we have endeavoured to be of service to those in trouble, by arranging a schedule of instalments which we find is very satisfactory. It is surprising to note the number of consumers who are not in a position to think for themselves financially, and yet, when taken in hand, they are quite willing to co-operate to the fullest extent, and many times we have succeeded in collecting our accounts in this manner. For example, rather than deliberately disconnect the consumer in arrears, if he shows a willingness to pay, we arrange his instalments to be sufficient to cover the current being used, and at the same time, reduce the arrears. If he were using approximately $1.00 weekly, we would suggest weekly payments of at least $1.50, and in the course of a few weeks, his account is entirely paid. In this way, we have maintained his good will and revenue, and he has been made a friend of Hydro. Remember, the treatment given any consumer by an employee or individual, if improper, or unfair, is revealed to the man on the street in criticism against the Hydro, not the particular employee and regardless of the department, care and courtesy should be shown the customer whether he is purchasing or in difficulty over his account.

We notify all our unpaid accounts a few days after the discount date, that unless paid in ten days, the service is subject to disconnection, and suggest that it is their responsibility to make arrangements at the Office before the given date. We make it a point to follow the matter up immediately after the disconnection date, and it is very seldom that a consumer has to be disconnected more than once to realize that the notice means exactly what it reads. We, of course, encountered some difficulty at first, but are today reaping the benefits of a set routine, and find that a great percentage of the consumers in arrears are making their arrangements with us, thereby cutting down the amount of collection work outside the office. This is proven by actual figures as our disconnects for the month of November, 1935, show a decrease of 87 from 1933, and 31 from 1934; also, out of better than eighteen thousand consumers at the close of November, 1935, we only had four disconnected for non-payment. A firm collection policy on a business-like basis has maintained for us, not only good will, but revenue.

One may ask, well what do you mean by a business-like policy? By this, I suggest that the consumer be dealt with in an open manner, rather than being treated harshly and deliberately cut off, and left to figure it out for himself. This method brings on the criticism of Hydro monopoly, which we have all heard, and does not collect your account or produce revenue. The best policy

is to come out frankly and tell the consumer the working of Hydro—"Its aim is to serve all", and it is not within your power to grant one any more consideration than another, but show him you desire to be of service to him, rather than be a hard-boiled collection agency, that has no further interest after the account is paid. We want and need their continued patronage. Even the most provoked customer resents the feeling that he is not doing his share, and when it is fully explained that if every consumer took the attitude that because we are a public utility, special consideration should be granted, Hydro would not exist, with the result that he sees our position in a different light. We have used this method on many occasions, and can recommend it thoroughly.

Do not be afraid to ask for your money when due; your job is to tell the customer when to pay, rather than the consumer paying as he sees fit. There is an unlimited moral effect from having the reputation of collecting your accounts. This has clearly revealed itself to us in our range campaign, as the number of refusals of credit average better than five applications from outside dealers, to one from our own shop, and we have at no time, taken any advantages because it was our own sale. People who are slow with us, hesitate to seek credit, knowing that we ask for payment of our accounts when due. This brings up a point on cooperaton of collecting accounts between municipalities; where a consumer has left an account unpaid. I believe every effort should be made to collect by the system serving this type of consumer, if for no other reason than to establish the fact that our collection policy is one that must be respected. We have always endeavoured to assist to the fullest, and find in making such a debtor pay, results in his account with us being most satisfactory because he has been educated on proper lines.

Although "Deposits" are not entirely a collection subject, the value is so closely associated with our accounts, I would like to touch on it briefly. We insist on a deposit from every consumer who is not the owner of the property where the service is being used, and on commercial services, set the amount sufficient to cover a sixty day period. This is done for the reason that although the commercial bills are issued monthly, by the time the discount date expires, and the account is followed up in the ordinary routine, there has been a further consumption of one month. True, we meet with opposition from a number, but this can be overcome by the following suggestion:—Compare the position of the public utility relative to that of an ordinary creditor. We are selling service to not a few, but all. The amount of credit to the individual is unlimited once his meter is connected, and we are called upon to do so when the applicant is good, bad or indifferent. The ordinary creditor knows the amount of credit required, and makes the usual credit investigations, and after consideration, can either accept or reject, it's his own personal affair. Again, in fairness to good consumers, I feel we are entitled to protection when the choice of granting service is not

within our power. It is not always possible to collect in full at the time of application, but we have many cases where we take sufficient to cover one month and collect the rest by instalments, thereby enabling the consumer to get started, and once operating and producing revenue, he does not protest as strongly. It is seldom we have much of a loss on a commercial account, and during the past year, we have not had a bankruptcy where the deposit was not sufficient to cover the bill. I am not overlooking the Public Utilities Act or Owner's Guarantee, but due to the great number of foreclosures and properties taken back by municipalities for taxes in recent years, the value of this security has decreased, unless records were kept up to date at all times, as to the actual owner of the property. We discourage owners signing guarantees and find in most cases, they are quite content as they are probably in an embarrassing position and hate to refuse the tenant, when approached.

In closing, may I suggest a collection policy, to be firm, with a set routine to aim at, that will at all times be a service of justice to all consumers.

C. C. Elvidge, Durham

Clifton C. Elvidge

Clifton C. Elvidge, Secretary of the Durham Public Utilities Commission, died in the Hamilton General Hospital, Hamilton, at noon, Thursday, February 13th, 1936, after a lengthy illness, aged 68 years.

Mr. Elvidge was born in Durham, Grey County, September 3, 1867. In early years he was employed as a druggist in different parts of Michigan and Ontario. Later he conducted a painting and decorating business in Durham. He was town assessor for 12 years and Librarian of the Durham Mechanics Institute and Durham Public Library for 33 years, up to the present time. He was Secretary-Treasurer of the Durham Horticultural Society for several years. He was Secretary-Treasurer and Manager of the Durham Hydro Commission (later the Durham Public Utilities Commission) since its inception in 1915, until the time of his death. He was well-known throughout the Eugenia district and was Secretary of the Eugenia Hydro-Electric Association for several years.

He was a great lover of sports having played considerable lacrosse and cricket during his earlier life; was an ardent lover of fishing and took great interest in the re-stocking of the trout streams of Southeast Grey.

Surviving him are his widow and five sons, two brothers and three sisters, to all of whom we extend our sympathy in their bereavement.

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Exhaustive Summary of Hydro Affairs

By Hon. A. W. Roebuck, K.C., M.L.A., Attorney General and Hydro Commissioner

(*Address delivered in The Legislature on March 3 and 4, 1936.*)

WHEN I addressed the House last year as one of the Members of the Hydro-Electric Power Commission of Ontario, I asked for the indulgence of the Chair for the time that I might occupy in my effort to make clear the situation, financial and otherwise, as I had learned it, with respect to Ontario's magnificent electrical enterprise. What I attempted was a task of some proportions, for I endeavoured to lay before the House a comprehensive explanation of the finances of the System, and a history of the transactions which had brought upon the power-users of Ontario a disaster of the first magnitude. The general outline of what I then divulged, will, no doubt, be remembered by my fellow-members and by the country generally. A year has now passed by since the revelations of the last Session, and I again approach a task of no insignificant dimensions. It is my duty to lay before the House, to the best of my ability, a history of the past year as it relates to Hydro, with all its difficulties and complexities, and as concisely as is warranted by the magnitude and importance of the subject. Once again I must bespeak the patience of the House, and its indulgence if I call for painstaking attention.

Hydro Commission Has Thirty Millions Revenue

May I again call your attention to the fact that the publicly-owned Hydro-Electric System of Ontario is the third largest commercial institution in the Dominion of Canada, being surpassed in amount of investment by only the Canadian National Railway and the Canadian Pacific Railway. The capital investment in the combined Commission and municipal plants, inventories, cash and other assets is over $400,000,000. It serves with power and light some 877 municipalities and companies, and supplies the light and power wants of approximately 630,000 customers. For the year ending the 31st

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Vol. XXIII No. 3
MARCH, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

of October, 1935, the total revenue of the Commission amounted to the impressive sum of $30,901,500.29.

It is not my intention to repeat on this occasion—at least not at any great length, the history of a series of power deals that well-nigh ruined this nagnificent public enterprise. That story has been told, and its sordid details are written indelibly into the history of this Province. What the Government and the Hydro-Electric Power Commission now faces are the results of the mistaken policies of our predecessors, and it is with these results that I shall be chiefly concerned.

ARE SIX GREAT SYSTEMS WITH SEPARATE ACCOUNTS

The Provincial Hydro enterprise is divided into six great Systems, the:

Niagara,	Thunder Bay,
Eastern Ontario,	Manitoulin,
Georgian Bay,	Northern Ontario.

I shall refer to them in the order named and separately, for financially they are run as separate enterprises with separate books of account and individual obligations and responsibilities. Each has its own liability to failure or success. While the various systems are thus distinct and separate, they nevertheless head up in a single executive office staff under one Board of Directors in the persons of the three Hydro Commissioners, and with a final unified financial responsibility. The condition of the combined whole can only be made clear by the picture as it appears in each one of the units, and I shall therefore commence my series of analyses with a discussion of the largest and most important division, which is known as the Niagara System.

* * * *

THE NIAGARA SYSTEM

THE NIAGARA SYSTEM HAS HUGE CAPITAL INVESTMENT

Generally speaking, the territory comprised in the Niagara System lies north of Lake Erie and Lake Ontario, and extends from the Detroit River on the West to a line running from Whitby on the East, and extending Northward to a line drawn East and West, approximately from the Southerly shore of Lake Simcoe. It will be observed that this district includes the most important industrial area, shall I say, in all Canada. In this district are to be found the Cities of Windsor, London, Hamilton and Toronto. It has a population of slightly over 2,100,000 people, whose enterprise and capital have made the territory one of the chief commercial centres of this continent. Last year the Niagara System had a capital investment of $210,272,000.00

I mentioned these facts because they form the background upon which one must judge the success or failure of a public enterprise which supplies

the district with its important element of light and power, and enables it by cheap service to compete with industries elsewhere, or by its failure, reflected in unnecessarily high rates, cripples our people and disables them in the industrial race.

Indicates a Condition of Health and Vigour

In the first place, let me tell you that the total revenue derived by the Commission from the sale of power in the Niagara System in the year ending the 31st of October, 1935, amounted to the very considerable sum of $22,102,070.12. That is a very great deal of money, and of itself is illustrative of the importance of Hydro in the business and domestic world. Moreover, this is an increase in revenue over last year of $684,-055.32. The revenues of 1935 were 3.2 per cent. higher than they were in 1934, which would seem to indicate a condition of health and vigour.

But unfortunately, I have to inform you that the cost of operation was considerably greater than the revenue derived. The total expenses of the Niagara System aggregated $24,972,-940.42, leaving a deficit of $2,870,-870.20.

Recurring Deficits are Viewed With Concern

A deficit of something less than $3,000,000 in the operations of 1935 might not appear serious to an institution with a capital investment as of this year, of $210,272,000, but unfortunately this is but the most recent of a series of deficits. The deficit which I reported last year for 1934 was $2,869,828, for 1933 it was $4,236,606, and for 1932, $2,544,648, making a grand total of deficits in the four years ending the 31st of October, 1935, of $12,521,952.00. There is no charge for contingencies or obsolescence in these figures, and no sinking fund on the Chats Falls and Decew Falls developments, and the Hamilton Steam Plant. A continuing deficit of nearly $3,000,000 last year and an aggregate deficit of over $12,500,000 in four years time is a condition of affairs much too serious to be viewed with anything but concern in a business community.

To make clear what has happened, I should again explain that for many years it had been the practice of the Commission to set up obsolescence and contingency reserves. In 1931 this fund stood at $14,631,725.88. In 1932 it had been reduced to $12,-443,323.82. In 1933 it was again reduced to $9,109,648.27, in 1934 to $6,570,115.56, and this year all that remains of that once splendid reserve is the sum of $3,848,843.66. Should the rate of loss be continued during 1936, this reserve would be exhausted by the end of the year.

Power Costs Increase One Half in Five Years

Had these deficits resulted from inordinately low charges for the power and light which the System has sold there would have been corresponding advantages. It might be unfair to depreciate the System's reserves, or to risk the resources of the taxpayer in order to sell power below cost to the industrialists and home-owners of the Province, but nevertheless the loss would be offset by a very material benefit. But this is not at all the case. As I pointed out last year, the average cost of power sold by the Commission

to all users in the Niagara System has increased by almost $10.00 per h.p. per annum in the past five years. This average is on a basis of neither addition to or withdrawal from the obsolescence and contingency fund. The figures are as follows:

1930	$20.84	per h.p.
1931	23.31	" "
1932	27.40	" "
1933	31.20	" "
1934	29.68	" "
1935	29.60	" "

Further Advances Not a Practical Solution

It will, of course, be quite obvious that the Commission has been unable to charge all the light and power-users of the Niagara District at the average rate of $29.60 per h.p. Such a rate is out of keeping with the potential competition of privately-owned steam and internal combustion plants. Further increases would likely result in hard-pressed industrialists and home-owners of the Province by running up the bill for power and light. The industrial and commercial interests of our people preclude the possibility of additional advances. Increased charges are out of the question, and unthinkable. This being the case, the Commission has not charged to its customers the true cost of power sold, but has drawn upon its reserves. For each horsepower which we sold in the Niagara System, to all customers, during 1935 we drew from the obsolescence and contingency reserves, on an average, the sum of $3.40, and we sold our power at an average rate of $26.20. This is the method of financing that has been followed for the last four years. In the years before 1932, we were adding to our contingency reserves with every horsepower that was sold, and since that time we have been depleting our reserves at an even increased rate. The figures are as follows:

Year	Average Cost per h.p.	Contingency Reserves		Charged
1929..........	$20.03	plus	$3.67	$23.70
1930..........	20.84	"	3.24	24.08
1931..........	23.31	"	.61	23.92
1932..........	27.48	minus	2.97	24.52
1933..........	31.20	"	5.43	25.77
1934..........	29.68	"	3.51	26.17
1935..........	29.60	"	3.40	26.20

decreased rather than in increased revenue; "like vaulting ambition that o'er-leaps itself and falls on t'other," Hydro rates have already reached the point where further advances would probably defeat themselves, but whether or not this is so, it would be a heartless Government indeed which countenanced further burdens on the

A comparison between the average cost of power on a h.p. basis and the price at which it is sold does not make clear, however, what would have happened to the municipalties had the Commission attempted to balance its budget at their expense. A considerable portion of the Commission's sales of power are made direct to industrial

companies. These companies have been charged the maximum rates available, but the gross returns have not equalled the cost of the power sold, on an accounting basis, by $5.99 per h.p. This does not constitute a just criticism on the Commission's management, for had there been no sales of power to the companies direct the System's losses would have been still greater. Figured on the basis of the municipal loads the loss on company power amounted to $2.07 for every h.p. sold to the cost municipalities. To this is to be added a loss of $2.50 on per horsepower on the municipal load for every horsepower sold to the municipalities. In the general Hydro set-up, the losses in the final accounting are to be borne by the municipalities, and, accordingly, had the Commission charged the municipalities an amount sufficient to cover its losses on both company and municipal account, it would have been obliged to charge the municipalities $4.57 additional on every horse-power sold to the municipalities.

The cost per horsepower together with the actual prices charged in some of the larger municipalities are as follows:

TORONTO.........	1935	Charged	$26.43	per h.p.
		Cost	31.00	" "
HAMILTON........	"	Charged	24.94	" "
		Cost	29.51	" "
LONDON...........	"	Charged	26.82	" "
		Cost	31.39	" "
ST. THOMAS.......	"	Charged	28.21	" "
		Cost	32.78	" "
KITCHENER.......	"	Charged	27.24	" "
		Cost	31.81	" "

These are typical examples of the workout in the larger municipalities. The average cost to the municipalities on this basis was $32.05 per h.p.

One naturally asks for an explanation of this unsatisfactory condition. With costs advanced by almost 50 per cent. in five years to a point approaching all that the traffic will bear—with power sold on an average at 14.26 per cent. below cost to the municipalities, and with consequent deficits over a four-year period amounting as high as nearly four and one-half million dollars in 1933 and $2,870,000 in 1935, one naturally enquires as to managerial efficiency, and turns in the first place to the operating account. Has the cost of operation been excessively high? Clearly justifiable charges of extravagance have been made against the former Hydro management, but while reprehensible in the highest degree and running into many thousands of dollars per year, they form but a small part of the explanation of an advance in cost amounting in gross, in rough figures, to approximately $8,000,000 this year over what would have been the cost had the conditions of 1930 prevailed. And moreover, the present Hydro Commission has effected some very outstanding savings in the matter of expense, as compared with the cost of operation under the previous Commission.

Reductions Are Made in Cost of Operation

In 1933 the actual cost of operation for the Niagara system was $4,243,-068.34. In 1934, notwithstanding certain economies effected by the present Commission during the six months in which the System was under its control, the cost was $4,292,313.92. During the past year the cost of operation was $3,881,-417.52, a saving over last year of $410,896.40, and over the previous year of $361,650.82. The Commission has reduced the salaries of its executive officers and Commissioners by $134,607 per year, as compared with the period preceding the 1st of July, 1934, and has made total reductions in salaries by reason of decreases and staff changes over the same period of $208,028.63 per year. Its legal expenses have been reduced from $114,-632.55 in 1933, and $56,262.64 in 1934, to $46,300.46 in 1935.

The Commission's auditing fees have been reduced from $51,292.04 in 1933, and $45,533.81 in 1934, to $15,265.39 in 1935.

Cost of Insurance Was More Than Cut in Two

The Commission's reduction in the cost of insurance is equally startling. There was paid to insurance companies in 1933 in insurance premiums the sum of $152,240.78, in 1934 $158,020.75, and in 1935, $65,018.15. To this is to be added an amount paid from a sum set aside by the Commission as an insurance reserve within its own control. On the 31st of October, 1934, the Commission transferred to an insurance account the sum of $50,000.00, as the initiating action of a future policy of providing for its own insurance protection. As risks came up for renewal, the Commission has credited to this fund the premiums on one third of its fire insurance coverage, the sum of $7,-515.49, and it has withdrawn from this fund for the payment of losses the very small sum of $37.50. The latter sum is the true cost of this insurance. If, therefore, this figure is added to the $65,018.15, it will be observed that the total cost of insurance in 1935 is the sum of $65,055.65, as compared with $158,-020.75 in 1934. In other words, the cost of insurance has been more than cut in two.

A saving of $410,896,40 on the cost of operation alone is no mean accomplishment, and the end is not yet—but this is by no means the only saving effected.

Interest Charges Down Capital Investment Up

We have increased our capital investment from $208,143,000.00 in 1933, to $210,272,000.00 in 1935—an increase of $2,129,000.00, and yet there was paid in interest and exchange $10,151,547.62 in 1933 as against $9,836;248.24 in 1934, and $9,590,-960.41 in 1935, a decrease over 1933 of $560,587.21.

In accordance with these figures the Commission's expenses of operation, interest and exchange have been reduced by $656,184.23, as compared with the expenses of 1934, and $922,-238.03, as compared with 1933—a saving on expense account of very nearly $1,000,000. per year, and this notwithstanding the fact that the Commission's business has increased in both the number of kilowatt-hours sold and in revenue received. In 1933

the gross revenue of the Niagara System was $20,089,523.37. In 1934 it was $21,418,014.80, and in 1935 it had grown to $22,102,070.12. There was an increase in revenue in 1934 of $1,328,491.43 over 1933, and in 1935 an increase in revenue of $2,012,-546.75 over 1933.

Gains Swallowed Up By Ever Mounting Exactions

I have already propounded the question as to why these losses, if the explanation does not lie in extravagance of management or undue reduction of rates. And I now advance another question. With an increase in revenue over 1934 of $684,055.32 and a total reduction in expense over 1934 of $675,077.65, or a total gain of $1,360,174.91, why is the deficit in 1935 of $2,870,870. within one thousand dollars of the deficit of 1934?

The explanation is simple. It lies in the improvident and outrageous contracts concluded by the former Commission and the former Government with the Eastern power companies. All that has been gained in increased business activity and advancing revenue due to a vigorous sales policy, and to reduced expenses due to economies of management, has been absorbed by the ever-mounting exactions under these nefarious agreements with the owners of Eastern sources of power.

I stated to the House last year that were these contracts continued and there was neither increase in revenue by reason of additional sales, nor reductions in expenses by reason of economy, the deficit this year would be $4,066,373.00. The fact that the deficit is two-thirds of that amount may be credited to good management and increased business activity.

The Commission Relied on Its Own Resources

It will be recollected that on the 11th of April, 1935, this House passed the Third Reading of a Bill to declare void and unenforceable the power purchase contracts with the four Eastern companies, but for reasons which I will later describe, the Act contained a provision that it would not go into effect until proclaimed by the Lieutenant-Governor-in-Council. The Proclamation did not take place until the 6th day of December, 1935. The Commission's books closed on the 31st of October, 1935, so that while the full amount of the contract charges have not yet been paid and may not be paid in full, these exorbitant exactions have been set up in their completeness in the accounting upon which my present figures are based. On this basis our cost of power from Gatineau, Beauharnois, Maclaren-Quebec and Ottawa Valley was last year the sum of $7,936,892.70, for a maximum amount of 619,000 h.p. The House will remember that last year I stated, as the result of a most painstaking calculation, that the Commission did not and never had required one single horse-power from the Eastern companies to satisfy its uninterruptible demand. That statement was ridiculed by the gentlemen opposite, but the experience of the last year has justified in actual operation the accuracy of the figures I then presented. In order to demonstrate beyond peradventure the actual requirements of the System the Commission instituted a new operating policy. One after the other, it opened

the switches which connected the Commission's transmission lines with the generating plants of Beauharnois, Maclaren-Quebec, and the Quebec side of Chats Falls, leaving itself dependent upon its own generating resources, and such power as it might take from the Gatineau plants.

Power Below Cost for Generation of Steam

At this point I should recall that due to the large quantities of otherwise unusable power, the former Commission entered into a number of agreements for the sale of electrical energy for the generation of steam, to meet the competition of coal in fuel-fired boilers. An average rate as low as $2.14 per h.p. was quoted and received. Granted the continuance of the otherwise unusuable surplus of power, these steam contracts were good business. The amount received, though small, was better than nothing.

Now when the Commission determined to end the Eastern purchase fiasco, it was not able to terminate abruptly its sales of steam power without such notice as the contracts provided, nor was it reasonable to do so under the circumstances. The result was that we carried on the peak, or that moment of maximum yearly demand which occurred on the 4th day of December, 1935, as much as 89,678 h.p. of steam-generation energy. We carried as well, 94,772 h.p. of interruptible primary power, and 30,429 of at-will secondary power, which for various reasons of public policy, the Operating Department under the Commission did not see fit to interrupt. In addition to this the Commission's peak in firm demand increased from 835,154 in December, 1934, to 839,008 h.p. in 1935, an increase of 3,854 h.p. There was, therefore, on the load in addition to the firm uninterruptible power for which the Commission had this year contracted, the following:

Steam	89,678 h.p.
Interruptible firm	94,772 h.p.
At-will secondary	30,429 h.p.
Increase in firm	3,854 h.p.
TOTAL	218,733 h.p.

Last Year's Calculations are Proven in Practice

We actually accepted from the one Eastern Power Company whose lines were connected with ours during the month of December last, a maximum of 202,000 h.p. It is therefore apparent that if we carried 218,733 h.p. of interruptible power on the peak, and we purchased from the Eastern companies only 202,000 h.p., we had actually available from our resources other than Eastern companies, 16,733 h.p., in excess of our uninterruptible demand.

In addition to this it should be pointed out that the capacity of the Commission's Niagara River plants, as stated last year, was 810,000 h.p. Conditions on the Niagara River have been worse this winter than at any other time since the first plant went into operation at Niagara Falls. Low water and drifting ice cut down the capacity of our two plants at the Cataract and the great plant at Queenston to as low as 727,000 h.p.—a decrease over last year of 83,000 h.p.

From these figures it will be observed that my estimate of spare capacity over uninterruptible demand as calculated last year has been

actually proven in practice to be under-stated. Without the Quebec side of Chats Falls, I said we had a margin of 75,000 h.p. It is true, and I pointed it out last Session, that some margin of supply is required over and above the exact amount used, but figuring this for this year's requirements at 100,000 h.p. in addition to our own resources outside of Quebec companies, we find that we had a surplus of unwanted power of 500,000 h.p., which at $15. per h.p. at the inter-provincial boundary cost the Commission the sum of $7,500,000.

PAID OUTLANDISH SUMS OWED FANTASTIC FIGURES

Is it any wonder that with a total unnecessary outlay of $7,500,000, the Commission should suffer a deficit of $2,870,000? Our total bill from these four companies for the year 1935 was the sum of $7,936,892.70, and it is interesting to observe that we have paid to these four companies since our first agreements commenced in 1928, to the 31st of October, 1935, the outlandish sum of $33,652,337.51, much of which has been actual and absolute waste, and were we to continue payments to the end of the contracts, it would involve an outlay of the fantastic sum of $382,500,000.00, or $172,500,000.00 more than our total capital investment in the entire Niagara System.

At this point may I take occasion to congratulate the Province of Ontario that it has in office a Government with the courage to face the facts of the financial disaster which I have just described, and to take such action as is necessary to rescue the power and light users of this Province from the ruin that has faced them, and may I compliment the Members of this House who supported the leadership of a courageous Prime Minister in their passage last Session of an Act to declare these iniquitous contracts invalid and unenforceable, and upon the resolution and public spirit which they showed on that occasion in placing in the hands of the Commission and the Executive Council, the power necessary to the carrying out of this Government's Hydro policy. The Act which they passed upon that occasion contained a provision that it was to go into force upon proclamation of the Lieutenant-Governor-in-Council, and I have told you that I would explain the reason for that delay.

ACTION WAS STAYED BY THREATS OF REPRISALS

That reason lay in threats of reprisals which we received from certain persons in the Province of Quebec should we dare to interfere with the stranglehold of the Eastern generating companies, and in the fact that in the Eastern System we were, at that time, vulnerable. The Eastern System, as its name implies, lies to the east of the Niagara System. It has a population of nearly 700,000 people, including the cities of Ottawa, Kingston, Belleville, Brockville and Oshawa, in addition to 16 towns and 32 villages—a total of 204 municipalities in which there are approximately 79,000 Hydro customers. Throughout this territory the Commission owns and operates thirteen generating stations with a normal capacity of 62,800 h.p. It carried a peak load last December of 107,185 h.p. This deficiency between the capacity of the Commission's own generating plants and its peak load requirements is supplied by 987 h.p.

purchased in the Province of Ontario, and the balance from the Province of Quebec.

Now it is an element in this situation that the power used in the Eastern System is generated at 60 cycles, while in the Niagara System it is 25 cycle, so that at that time it was not possible for the Commission to place at the disposal of the Eastern territory any portion of its Niagara electrical supply, and we were threatened from the Province of Quebec that should the Government cancel these contracts between the power companies and the Niagara System, the authorities in Quebec would cut off the supply of the Eastern System.

Eastern Cities to be Plunged into Darkness

I have in my hand a report of an interview with Mr. Aime Geoffrion, K.C., which was published in the Star on the 9th of May, 1935, in which that gentleman publicly states the threat which this Government had already received on a number of previous occasions, from other sources which it is not my privilege to disclose. Mr. Geoffrion is a Director and legal advisor for the Beauharnois Corporation, and is a noted Counsel and distinguished member of the Bar of Quebec. Speaking in Toronto in May last year, Mr. Geoffrion said:

> "Premier Taschereau will probably take a very definite stand for a continuance of the present agreements in modified form, or no power at all from Quebec. That may seem a very unneighbourly attitude, because if Quebec power is shut off, all Ottawa and most of Eastern Ontario will be plunged into darkness, and in many cities the wheels of industry will be stilled."

That statement, as I have said, is the public announcement of a threat which the Government had received in still more emphatic terms, from sources which could not be disregarded. But unfortunately for Mr. Geoffrion, when his public statement was made, the Commission and the Government had already taken steps to parry the thrust.

Commission Purchased a Frequency Changer

Mr. Geoffrion made his speech on May 9th, but on April 4th preceding, an item appeared in the press which conveyed to the Commission some very valuable information. It was stated that work had been stopped at the Westinghouse plant in Hamilton on the construction of a 60,000 h.p. frequency changer, as a result of the Government's action in cancelling the power contracts. This was the first intimation to the Commission that such a machine was in existence or in prospect on the continent of America, and an engineer in the Commission's employ was immediately despatched to Hamilton on a scouting expedition. He reported that the Westinghouse Company had completed the preliminary work for the construction of such a machine upon the strength of an order from the Maclaren-Quebec Company. Many months had been spent upon the design. Dies had been struck and materials purchased, but due to the uncertainty with respect to its contractual relations with the Hydro Commission, the Maclaren Company had cancelled the contract. It was learned that under pressure, this great frequency changer could be completed and installed by the 15th of October of that year. A price was asked from the Westinghouse Com-

pany. The price was reported upon by the Hydro's engineers, who stated that it was fair and reasonable, and the Commission had further assurances in this regard in the fact that the price quoted to the Commission was the same as that to be paid by the Maclaren Company.

Machine Was Justified on Operating Basis

The engineers also reported that a frequency changer between the two Systems had for some time been recommended by the Engineering Committee, in the interests of operating efficiency. The purchase, they said, was justified on an operating basis, aside entirely from the emergency conditions then confronting the System. Under these circumstances the Commission promptly obtained the approval of the Government and placed its order for the machine. Work was recommenced in Hamilton on a three-shift basis. The men continued in their employment, and the great machine was hurried to completion.

It may be that Mr. Geoffrion later enjoyed a laugh at his own expense, when on the 18th of June following, an item appeared in the press that the Hydro Commission had men working at Chats Falls on the installation of what was referred to as a "60-cycle motor" for the supplying of power to the Eastern District. It is probable that he then realized that when he made his famous speech in the City of Toronto threatening to plunge the Eastern District into darkness, and to still the wheels of its industry, the Hydro Commission was at the very moment rushing to completion an addition to its equipment which would make that great district independent of Quebec power. I trust that the country will now perceive one reason for the long delay in the much-heralded conferences between the Ontario Government and the power companies and of the numerous and highly-publicized prospective conferences between the Prime Minister of Quebec and the Prime Minister of Ontario, which somehow, did not take place.

System is Freed From Dependance on Quebec

True to schedule, the foundations were laid by the Commission's Construction Department and the great machine was assembled at Chats Falls and was delivered complete and in place by the Westinghouse Company on the 15th of October, 1935. A few days afterward the Commission cut off its entire supply from the Gatineau Company, and 60,000 h.p. surged through the great machine at Chats Falls and took up the burden of the Eastern District without so much as the flicker of a light. In the meantime the Commission had been active in many directions readjusting its complicated electrical system to the receiving of its supply from its Niagara plants in substitution for the power which formerly arrived via the Gatineau line. For seven years the Hydro System had been building on the basis of power from the East, and an almost unbelievable number of minor changes and arrangements were required for the adjusting of the System to supplies from the West. To outward appearances, the Commission was enjoying a period of stalemate and delay, in striking contrast to the almost feverish activity within. The truth is that Hydro

was working Mr. Hepburn into a hitting position, and was preparing to protect itself and those depending upon its services, from the threatened sabotage of these favoured customers.

Opened the Switches Refusing Quebec Power

The System was now in a position to protect itself, and accordingly on October 21st, the Commission commenced to pull its switches on the power companies. By October 22nd we had ceased taking power from Ottawa Valley Power Company, the Maclaren-Quebec Power Company, and the Beauharnois Company.

Financial Interests to Humble this Province

But the threat of power shortage in the Eastern District was not the only attack upon the Province of Ontario in connection with the power companies. I hold in my hand a newspaper despatch from the City of Ottawa, dated the 4th day of April, 1935. It reads as follows:

"Ottawa today saw no problem in Premier Hepburn's query, 'What are they going to invoke to make us pay, under the power contracts entered into by the Ontario Commission, with the Quebec power companies.'

" 'The banks will simply shut off credit, and Ontario will become a new Chicago,' it was declared.

" 'Even Mr. Hepburn won't be able to collect his salary, nor will any Ontario public servant, if a serious effort is not made to save him from his own folly,' a cabinet Minister said, after confessing he did not know whether or not Mr. Bennett had made any decision on disallowance of the Ontario Act to declare the contracts invalid.

That the threat which eminated from the financial interests at Ottawa and as voiced by a Cabinet Minister of the Bennett Government was no idle threat was later abundantly proven. Under its former contract with the Maclaren-Quebec Company the Hydro was obligated to take an additional 27,000 h.p. on the 1st of July, 1935, and on the 10th of June, 1935, the press carried the news that the Hydro management would refuse to accept delivery. This was the first overt act which conveyed to the financial interests the unwelcome news that the Government of Ontario was in deadly earnest in connection with the power contracts, and actually intended to carry out its resolve to protect the power-users of the Province. Now it happened by a mere coincidence that about the same time the Ontario Government offered for sale an issue of Provincial bonds of $15,000,000. It is not my intention to recount at this time the details of the incidents that followed. Sufficient to say that St. James St. combined with Bay St. in an attempt to discipline the Government of Ontario for its power policy and to coerce the administration of the Hydro Commission into submission to the power barons, by a conspiracy to cut off its financial supply. The situation is best described in a statement which Mr. Hepburn issued at the time. The Prime Minister said:

Government Challenged by Dictators of Finance

"The financial interests undertook to discipline the Government of Ontario because of its stand on the power purchase question. Those in control of the centralized money machinery combined in an attempt to coerce the Government into submission by refraining in unison from bidding on its bond offering. Some days ago the Province advertised for sale $15,000,000 worth of its securities, and by a coincidence the Hydro-Electric Power Commission of Ontario simultaneously declined to accept a further delivery of 27,000

h.p. from the Maclaren-Quebec Power Company. The Hydro is already paying $6,000,000 annually to the eastern power companies for surplus or unneeded power. The Hydro has refused to accept further deliveries and penalize further the people of the province of Ontario to the extent of approximately $3,000,000 for power purchased under contract but as yet undelivered. In their efforts to compel the people of Ontario to continue bearing this impossible burden, the financial interests have consolidated and have undertaken to force the Government to surrender.

"The challenge is not to the administration, but to popular government and to the people themselves. Sooner or later the issue had to come. The would-be invisible government must be taught that the power of money stops somewhere. The welfare of the people and the future of this province is paramount. The plain issue is whether the country is to be governed by elected representatives or by the dictators in control of the machinery of money."

As everyone knows, the Government won, and the credit of the Province stands higher today than at any time in all history.

The people of Ontario flocked to the support of a courageous Government and the answer of the Commission was a further refusal of additional deliveries, falling due as follows:

Beauharnois Power Corp.	67,000 h.p.	Oct. 1, 1935.
Maclaren-Que. Power Co.	33,000 h.p.	July 1, 1936.
Beauharnois Power Corp.	54,000 h.p.	Oct. 1, 1936.
Maclaren-Que. Power Co.	25,000 h.p.	Nov. 1, 1936.

The Commission Asks For Government Action

As I stated before, the Commission had demonstrated its ability to rely upon the resources of its own System, and on the 19th day of October, 1935, the Commission forwarded to the Government, a resolution which reads as follows:

"Dear Mr. Prime Minister:

At a meeting of the Commission held on Friday, October 18th, 1935, at which all members of the Commission were present, it was unanimously decided by the undersigned to forward to you the following recommendation:

The Hydro-Electric Power Commission of Ontario recommends that the Power Commission Act, 1935, be forthwith proclaimed.

The Commission advises that it is in a position to carry on its operations, and give all essential services to the power and light users of the Province, without dependence on power supplied under the agreements mentioned in the said Act."

This resolution was published, and as already stated, by the 22nd day of October, the Commission had opened the switches on Beauharnois, Maclaren and the Ottawa Valley Company, and had reduced its take from Gatineau to 201,000 h.p. Accordingly the power companies approached the Government for a conference. A meeting was held in Toronto on the 23rd of October, 1935, with all four companies represented, and with the full Cabinet present. The representatives of the companies were heard, and at the conclusion of the meeting the Prime Minister handed out the following statement.

The Government Confers With Power Companies

"A conference took place this afternoon between the Cabinet, and representatives of four power companies with generating plants in the Province of Quebec. The companies represented were: The Gatineau Power Company; the Beauharnois Power Company; the Maclaren-Quebec Company; and the Ottawa Valley Power Company. The conference came about as a result of the recommendation of the Hydro-Electric Power Commission that the Act of last Session be

forthwith proclaimed, together with the advice that the Commission is now in a position to carry on without further deliveries from the companies in question. On the publication of this recommendation a wire was received by the Government from three of the associated companies asking for a conference.

"It opened with a statement of the position in which the Hydro Commission finds itself. It was pointed out to the representatives of the companies that the Commission is now purchasing as much as 525,000 h.p. at $15 per h.p., or approximately $8,000,000 a year for energy, none of which is actually required, in addition to maintaining the transmission line at an annual cost of $1,400,000. As a result of payments for unneeded power, the Commission had suffered a total deficit since the power contracts were inaugurated of more than $12,000,000.

"The amount of power deliverable under the contracts has been constantly increasing. Between July, 1934, and July, 1935, there was an increase of $1,000,000 of power. Due to various economies the Hydro-Electric Power Commission had reduced its expenses by approximately $1,000,000 a year. This had been entirely wiped out by the increases in power payments mentioned. In July of last year the Commission refused to take further increases and the saving on that account is as much as $4,000 a day. Should the contracts stand until 1936 the deficit for that year would amount to $5,000,000. When the contracts are operating at their maximum they require a payment of approximately $11,000,000 per annum.

"Under these circumstances, it was pointed out to the representatives of the companies that the Hydro was not in a position to temporize with this question of Eastern power contracts, but to protect the interests of the light and power associations was driven to action.

"In reply to this statement of case, representatives of the power companies asked that they be given an opportunity to make a concrete offer to the Government regarding concessions to be made by them.

"The conference was accordingly adjourned in order that the representatives of the power companies might confer among themselves and obtain such further information as might be required.

"They expressed the hope that a settlement might be arrived at that would save the companies from bankruptcy and yet relieve the Hydro of purchased but unsaleable power.

"The negotiations will continue between the representatives of the companies and Hydro and will be referred back to the Cabinet in due course."

Bond Mortgages Tied The Companies Hands

As intimated in the report, negotiations did continue, and a further meeting was held between the Government and the companies, but the companies were unable to agree among themselves. The Gatineau Company, argued, and with some force, that as it had the original contract it should enjoy a preferred position. To this the other companies would not consent, and moreover the company managements appeared to be quite unable to reach an understanding with the holders of their bonds, and it became quite obvious that the companies were unable to alter the agreements because of the terms of their bond mortgages. I have in my hand the trust deed of the Maclaren-Quebec Power Company, under authority of which that Company issued bonds in the amount of $18,000,000 on the security of a pledge of its assets. On page 26 of this document there appears the following paragraph:

"It is further hereby declared and agreed that any and all of the said agreements referred to in sub-clause (ii) of sub-clause (a) of Section (1) of this Article 4 may from time to time be modified, added to, cancelled or replaced by the company with the approval of the Trustee, provided that the Trustee be of the opinion that such modification, amendment, addition, cancellation or replacement will not be prejudicial to the interests of the bond-holders, upon such terms and conditions as the Trustee may impose."

I have also in hand a Trust Deed of the Gatineau Power Company securing an issue of $37,500,000 of bonds, on a pledge of the Company's assets. On page 98 of this document there appears the following paragraph:

"The Company will not consent or be a party to any other change in any of the said contract except such as in the opinion of the Board of Directors of the Company, expressed in a resolution authorizing or approving the change, and adopted by a majority of the Board of Directors at a meeting duly held, are important to the proper administration of the contract or to the relations between the Company and the other Party to the contract, or are otherwise in the best interests of the Company and the bond-holders, and involve no fundamental reduction from the basis specified in the contract in respect to the quantity of power covered thereby or the price of power there-under."

GOVERNMENT PROCLAIMS ACT OF CANCELLATION

It is quite obvious on a reading of these paragraphs that the companies were not in a position to deal without the consent of the bond-holders, and it seems that no machinery was set up in the Trust Deeds for enabling a Committee to act in such a matter on behalf of the individual holders. It would appear that unanimous consent of the bond-holders was required to an alteration of the agreements which would fundamentally affect either quantity or price. The inability of the companies' managements to deal on their own authority was admitted in the second conference between the Government and the power companies, which took place on the 7th of December, 1935, and the companies admitted that they had no authority from the bond-holders. Obviously, therefore, the only way in which the companies could be relieved from their binding obligations with respect to the agreements as defined in their own trust deeds was the cancellation of the agreements by the proclamation of the Hydro Power Commission Act, 1935. This was accordingly done, and at the close of the conference the Government issued the following statement:

AN IMPOSSIBLE OFFER

"The Ontario Government this afternoon met representatives of the Quebec Power Companies, and after prolonged negotiations failed to reach any agreement. The proceedings finally closed in the Premier's office, when, in the presence of all members of the Cabinet and Mr. Symington, as spokesman for the Beauharnois, Maclaren and Ottawa Valley Company, and of Mr. Graustein of the Gatineau Company, the Prime Minister announced that, in view of the companies' inability to submit any offer which was possible of acceptance, the Government would forthwith proclaim the Power Act, and would refer to the Hydro Commission the question of the future purchase of power, on the distinct understanding that no more power will be purchased than is actually required.

"Continuation of negotiations as to purchase of the Hydro requirements must necessarily await the conclusion of the Ottawa conference. In the meantime, conditions as they now exist will continue.

"No power is now being received from Beauharnois, Maclaren or Chats Falls, and a limited amount of approximately 85,000 horsepower is being taken from Gatineau on the primary demand, and about 113,000 for steam generation purposes.

"The companies had not been able to agree on a combined offer. Beauharnois, Maclaren and Ottawa Valley joined in one offer, and Gatineau made a different offer on its own behalf.

"The three companies offered to reduce the amount of the Hydro's aggregate commitments, including Gatineau, from 733,000 horsepower by an amount of 191,440 horsepower, leaving the Hydro to absorb a balance of 542,000 horsepower. An abatement in price was suggested, and refused, so that this amount of power at $15. per horsepower

would involve a payment annually of $8,130,000.

A Heavy Loss

"Aside from the energy now being temporarily used for the production of steam, as the Hydro's requirements this winter will not exceed 100,000 h.p. primary demand, or, at the contract price of $15., an amount of $1,500,000, the companies' offer was on a basis of loss to the Hydro of $6,630,000 per year.

"This, the Government immediately announced to be impossible, notwithstanding that it was pointed out that the loss would decrease should the demand for power increase.

"The Prime Minister inquired as to whether the representatives of the companies were armed with authority to amend their contracts. The reply was in the negative. It was admitted that no accredited representatives of the bond-holders were present. It was thought, however, that the bondholders would later approve some reasonable concession.

"Spokesman on behalf of the Hydro Commission asked if the companies were prepared to sell to the Hydro the amount of power that the power users required and no more. This suggestion on behalf of the Hydro was declined by the companies.

Reached an Impasse

"The parties having reached an impasse, the conference was adjourned in order that the Government might meet with the representatives of the Gatineau Company.

"As spokesman for the Gatineau, Mr. Graustein offered a revision of the contract by the elimination of certain objectionable features. The company was not prepared to surrender its complete rights to shift to the Hydro increased costs due to new Quebec taxation. This reservation, the Premier declared, was fatal to any agreement.

"The Gatineau Company proceeded to offer to supply the Hydro with the 100,000 horsepower required for this winter's maximum demand and to continue to supply power in additional amounts as demand grows, throughout the years until the full 260,000 horsepower mentioned in the contract is again absorbed.

"The power at present being used for the generation of steam, the Gatineau is prepared to continue to supply until such time as the Hydro's customers can equip their plants for the production of steam by coal-fired boilers, and to charge for this energy pro rata on the basis of the time for which it is used. This power is now being sold by the Hydro at less than $2.25 per horsepower, though purchased at $15. per horsepower, involving an annual loss of over $2,000,000.

Act Proclaimed

"Following the conference with the Gatineau representatives, the Cabinet went into Council. The situation was fully considered, and in view of the altogether unsatisfactory offers received and the inability of the Company representatives to surrender the contracts for revision without further authority from the bondholders, it was decided that the Act must be proclaimed. An Order-in-Council was accordingly passed and the fact was announced to the companies.

"Further negotiations will be carried on by the Hydro Commission for the purchase by the Hydro of the power it actually requires and no more."

Hydro Enemies are Within and Without

The battle with the power companies had now reached a critical stage. The definite step of cancellation had been completed. The future of the Ontario Hydro System was hanging in the balance. With the courage seldom if ever equalled by any public man in the history of Canada, Mr. Hepburn, in his capacity as Prime Minister had accepted the final responsibility as head of the Government, in a declaration of war against the millionaires of the financial districts, and the power octopus which had held Ontario in its grip and had drained its domestic and industrial power users of many millions of dollars.

Under such circumstances one would have imagined that the Leader of His Majesty's Loyal Opposition would have refrained from joining

hands with the enemy and giving comfort to the foe, and attempting to embarass the Province's responsible representatives in the discharge of their difficult and responsible duties. Rules of parliamentary debate make impossible a fitting description of the quality of the act of the Leader of the Opposition when he actually suggested that the power companies open the sluice gates on the Quebec side of the Chats Falls development, and sabotage the Commission's generating plant.

Suggests Sabotage of Hydro Generating Plant

I hold in my hand a press report of an interview on the day following the proclamation of the Act in which the Leader of the Opposition took sides with the power companies in their battle against the people of Ontario, and actually suggested and apparently justified the theft of Ontario's waters by the Quebec companies, in an offensive warfare to cripple the Commission's plants, and by bringing about a power shortage in the Niagara System, compel the Hydro Commission to pay to the power companies the price of peace. It is to the credit of the power companies that they refrained from a criminal act of open warfare on the Commission, to which the Leader of the Opposition had egged them on. This is what he said.

> "I wouldn't be surprised if Premier Hepburn reconsiders his decision before very long, when he finds out what he has done," former Premier Geo. S. Henry predicted to-day, asserting that Ontario's cancellation of the Quebec power contracts had left Hydro powerless to prevent the Ottawa Valley Company from opening its sluice gates at Chats Falls, thus ruining Hydro's half of the joint development.

Nor does it add anything of credit to the sorry picture of the honourable gentleman in this connection, when we learn of the glee with which he observed the supposed predicament of the power-users of the Province. I read from his published interview,

> "So that is the kind of insurance for Ontario Hydro that Mr. Roebuck has," laughed Mr. Henry. "We need Chats Falls, for we cannot generate even the power on our side of the River without their co-operation."

The time may come when the honourable gentleman will laugh on the other side of his face.

Sided With Companies and Justified the Price

When one realizes that the Prime Minister had invited the power companies to send their salesmen to the Hydro Commission, with a suggested hope that they might perhaps sell power, one might perhaps have expected the Leader of His Majesty's Opposition to refrain at this point from attempts to boost the price, and yet we find the Member for York East declaring that $15.00 per h.p. is justified. This is what he says:

> "Premier Hepburn's continuation of the $15.00 per h.p. price for the power still purchased from Gatineau showed that the $15.00 price apparently is justified," Mr. Henry asserted.

Evidently the gentlemen opposite are still prepared to accept 733.000 h.p. from their power baron friends and to pay a price of $15.00 per h.p. or $10,965,000 per year. They have done everything in their power to bring that result about. The country has not yet forgotten the thirty-six hour filibuster staged by the Conservative Opposition in this House at its last session in their futile attempt to prevent the passage of the Power Bill. And may I remind them of the declaration of the Leader of the

Opposition of that time that "the Niagara and Eastern Ontario Systems are now taking sufficient power to warrant continuing the contracts."

Threatens to Revive the Cancelled Contracts

Nor can one forget the implied threat of the former Attorney-General, the Member for Parkdale that should the Conservative Party be returned to office, it would repeal this Government's Power Act and re-establish the contracts with the power barons. I read from a newspaper report of the honourable gentleman's speech in this House on Friday, the 12th of April, 1935:

"If this Government can repudiate, perhaps the next Government will come along and repudiate the acts of this Government."

The suggested attack on the Commission's Chats Falls plant, and the attempt to maintain the power price at $15.00 per h.p. is in keeping with the policies pursued throughout by the entire Conservative Opposition. The Act was no sooner proclaimed than the Member for South York, former Minister of Highways, rushed to the aid of his power baron friends. I read from the press report of his interview on the 7th of December, 1935:

"Cabinet action is a grave mistake. This removes the last hope that by amicable settlement Premier Hepburn might repair the harm done by passage of the repudiation legislation."

And even my friend from Toronto High Park takes up the cudgels for the power companies and their exhorbitant price.

"Continuation of purchasing power from Gatineau at $15.00 per h.p. is an admission by the Hepburn Government that the price was right. I hoped when the Government delayed so long in proclaiming the Act that the Government concluded it made a mistake and was trying to get out of it gracefully. I have a great deal of admiration for Mr. Hepburn's courage but he has been badly advised by his Attorney-General."

No Motor Stopped and No Light Went Out

The events of the next few days proved how groundless were the Opposition's fears, and how unjustified was their attempt to maintain the $15.00 price. I stated when the cancellation of the contracts was announced that not a motor would stop turning, and not a light would go out. That prediction was fulfilled, and in due season the power companies sent their representatives to deal with the Hydro Commission. A totally different situation was then presented. The contracts had been cancelled, and the companies were free from attack by the bond-holders in entering into new agreements, and on the 20th of December, 1935, the Hydro Commission accepted in broad outline, and subject to confirmation by the Government, the terms of agreements which have now been executed in formal documents. It is my privilege to bring to the attention of the House the new agreements, by which the Government and the Commission have secured for the Province both its present and future requirements, limited however to amounts which can actually be used, at prices in striking contrast with the improvident agreements which have been cancelled. I shall deal with the Gatineau new and old agreements first.

Companies Enter Into New Power Agreements

The working conditions of the two agreements are of sufficient similarity that nothing is to be gained by reading many of the clauses important in

themselves. I shall content myself with noting the striking comparisons between the two agreements. Under the old contract, deliveries commenced on the 1st of October, 1928, and were completed at 260,000 h.p. on Oct. 1, 1931, and were to continue for a period of 30 years from the first-mentioned delivery. Under the second agreement, 260,000 h.p. is to be held available for a period of 10 years from November 1st, 1935, and terminable then or thereafter on two years' notice. Of this 260,000 h.p. held available, 201,000 h.p. is to be taken to the end of April of this year, and after that date a minimum of 100,000 h.p. only, unless otherwise ordered, together with 33,000 h.p. of immediate stand-by. The balance is to be held for delivery on one week's notice, and is known as a general reserve.

Under the old agreement, the price to be paid was $15.00 per h.p. for the full contract amount, which after the 1st of October, 1931, was 260,000 h.p., and so continued, whether or not required or accepted by the Commission, for the full 30 years to the end of the contract. Under the new agreement, the power actually taken by the Commission, with a minimum of 100,000 h.p. is to be paid for at $12.50 per h.p., and the price of the 33,000 h.p. of immediate stand-by is $10.00 per h.p., with $1.75 per h.p. for the general reserve. The purpose of the stand-by power is to provide immediately available spare capacity in case of temporary stoppage of the Commission's other purchased supply, or from its own generating plants, apparatus, or equipment, the result of accident, wear-and-tear, need for repair or abnormal ice conditions. It is a term of the contract that what power is ordered in writing by the Commission, shall be paid for to the end of the contract term at $12.50 per h.p. per year, but should the Commission call upon the immediate stand-by for the purposes mentioned, the amount taken is not added to the contract demand and the call is terminated so soon as the emergency goes by.

Stand-by Power Added to The General Reserve

The clause of the agreement in question is as follows:

"The Commission shall be entitled under the provisions of this clause, without increasing thereby the contract demand, to delivery of such immediate stand-by power as may be necessary, for use of its own available spare capacity, to replace any contracted supply unavailable for the time being, due to any one or more of the causes below-mentioned, or any part of the product of its own plant, apparatus or equipment, temporarily out of service due to accident to equipment, or apparatus, or to wear-and-tear, or to need for repair, or to abnormal ice conditions, or operating at reduced capacity due to one or more of these causes, but not so as to increase thereby by the addition of immediate stand-by power, the power and energy available from the Commission's own plants and equipment and contracted supply as it would have been but for such causes; the Commission shall take all reasonable steps to remove or correct such causes as soon as possible; no such delivery of immediate stand-by power will be used to provide for increased load in the Commission's System by reason of bona-fide increases in demand by the Commission's customers; no plant, apparatus, or equipment shall be voluntarily taken out of service for the purpose of repair in the months of November, December and January unless in cases of absolute emergency."

Additions to the contract demand are to be taken from the general reserve until that is exhausted, then

from the immediate stand-by until 260,000 h.p. has been accepted, and thereafter all power taken is to be paid for to the end of the 10-year term, or until the contract is terminated, at $12.50 per h.p. This $12.50 covers not only the 260,000 h.p. which the Commission shall have at the time ordered, but in addition, entitles us to call on the Company's equipment and spare equipment up to the limit of its overload capacity.

Payments to be Made in Canadian Funds

Under the old contract interest on arrears in payments was charged at 7 per cent. Under the new contract it is 5 per cent. Under the old contract, when the export of gold from Canada was under embargo, as has been the case for some years, payments were to be made in New York funds. Under the new agreements, payments are in lawful money of Canada, and are to be made in Toronto. How important is this item in the new contract can best be illustrated by a statement of the amounts expended under the old contract on this item of exchange since 1931. During the five years just passed, the net balance as against the Commission on account of exchange, made necessary by the Commission's obligations under the 25-cycle Gatineau contract to pay in United States funds, has cost the sum of $945,838.82. In other words, this simple little clause in the former Gatineau contract for payment in United States funds has cost the Commission in the last five years, very nearly $1,000,000.

Will Pay Own Taxes in Province of Quebec

Under the old contract, the Commission was obligated to compensate the Company for any Dominion or Provincial taxes, rentals, licenses, fees or charges not then in existence at the time of the contract, and for any increases in such existing charges. That is to say, if the Province of Quebec levied new, or increased old taxes upon the Gatineau Company, so as to increase the cost to the Company in respect to the power effected by the agreement, the amount of the increased cost was to be added to the price of power, and the power-users of Ontario were thus liable to taxation by the Province of Quebec. Under the new agreement, no compensation or modification of rates is to be paid to the power company by the Commission on account of taxes, rentals, licenses, fees or charges imposed by any Government outside of the Province of Ontario, including the Dominion Government and the Government of the Province of Quebec. The Company pays its own taxes and such charges levied upon the Company in respect of its business or property in the Province of Quebec, and all the Commission pays is such taxes as may be levied by the Province of Ontario on account of the Company's 10 feet of transmission line within the Province of Ontario.

Under the old agreement, the Company was not liable for partial or total failure to deliver power, due to the act of the Province of Quebec. In other words, the Government of Quebec could at any time interrupt the supply should the power be needed for Quebec industry and for any other reason within its own sweet will. In other words, the energy contracted for was "at-will" power. Under the new agreement the contract is firm,

and there is no provision exempting the Company from liability from failure to deliver power under the terms of the agreement, due to any act of the Province of Quebec.

The development of power on the Gatineau River is dependent upon a continuance flow of water at all times in the Gatineau River. A steady flow can be maintained only by the storing of water in large quantities in the upper reaches of the River. Under the old agreement the Company was obligated to provide a storage capacity of 82,000,000,000 cubic feet. Under the new agreement this is increased to 140,000,000,000 cubic feet. As an assurance against the failure of power following seasons of drought, this added storage is of real value to the Commission.

New Agreements Legal Obligate Both Parties

Under the old agreement the Gatineau Power Company agreed to deliver its energy to the Commission at a point 10 feet within the Province of Ontario. Its contract was, accordingly, an undertaking to construct works to connect one Province with another, or to extend beyond the limits of a Province. Due to the fact that the Gatineau Company was incorporated under the legislative powers of the Province of Quebec, this was beyond its corporate powers, as the construction of works connecting one province with another, or extending beyond the limits of a province is specially reserved in the British North America Act to the legislative competence of the Dominion Parliament. Under the new agreement, the Gatineau Company delivers its power to the Gatineau Transmission Company, a Dominion incorporation, and this company conveys it across the border for delivery to the Commission, within Ontario, 10 feet from the inter-provincial boundary. In other words, this is a legal, valid and binding contract which may be enforced against the Company, and as well against the Commission, while the old contract was illegal, void and unenforceable; and by way of further assurance, the Gatineau Power Company guarantees delivery by the Transmission Company. Then lastly, the new agreement is to be construed in accordance with the laws of Ontario, while the old agreement was silent on this point.

The agreement I have just described is for the delivery of 25-cycle power to the Niagara System, and a further agreement has been entered into with the Gatineau Company for the delivery of 60-cycle power to the Eastern District. The general terms of the 60-cycle agreement are similar to those contained in the agreement with respect to the 25-cycle power, and I shall refer to its specific terms when dealing with the finances of the Eastern District.

Have Now Ample Power for Present and Future

In addition to the 100,000 h.p. firm, and 160,000 h.p. of immediate standby and general reserve ordered from the Gatineau Power Company for the Niagara District, the Commission has entered into a further agreement for the supply of 40,000 h.p. from the Maclaren-Quebec Power Company, at a price of $12.50 per h.p. Deliveries commenced under this contract on the 1st of February, 1936, so that the Commission has now available to carry it through next winter's peak,

140,000 h.p., in addition to the generating capacity of its own plants, and a small block of 20,000 h.p. from the Canadian Niagara Power Company at Niagara Falls. Reference to the information I have already supplied as to the peak demand of December just past will indicate that this is an ample supply for all the Commission's needs, and it has besides 160,000 h.p. by way of added assurance, and upon which it can call as circumstances may warrant.

The objectionable features of the old Gatineau contract to which I have just referred, have been similarly eliminated from the Maclaren contract. It will pay its own taxes in the Province of Quebec. Its agreement for delivery is firm and not voidable by the Quebec Legislature, and its term of forty years has been cut down to a moderate and common-sense period of 10 years, or to such time thereafter as it may be terminated on two years' notice by either party. The old contract rate was $15.00 per h.p. for 125,000 h.p., irrespective of whether the energy was required or accepted. The present agreement is for 40,000 h.p. only, and the charge has been reduced by $2.50 per h.p., to a price of $12.50 per h.p.

Ottawa Valley Company Broke Off Negotiations

It will be observed that in the Gatineau contract the Commission agrees to take from the Gatineau Company such increases as it may require up to 260,000 h.p., but not so as to in any way interfere with its right to construct new plants or to enlarge the capacity of its existing generating system, and it will also be noticed that there is specially reserved the right to contract for 40,000 h.p. from the Maclaren Company, and such power as the Commission may take from the Quebec side of Chats Falls. No contract, has, however, been entered into with the Ottawa Valley Power Company, the owners of the Quebec side of the Ottawa River plant. The Commission was in course of negotiations with the owners. An offer had been made to rent the plant at a figure, however, which was in excess of what the Commission was prepared to pay, and the Commission had requested the Company to make it an offer for the sale of its plant and water rights. While the negotiations were in progress, and before naming a figure at which it would sell, the Company, without prior notice, issued a writ and commenced action. There is, accordingly, nothing further to be said in reference to this company, as its rights and those of the Commission are subject to pending litigation.

Beauharnois Offer Was Quite Impossible

Nor has any contract been entered into with the Beauharnois Light Heat & Power Company. The offer of that company was not acceptable for a number of reasons. In a letter to the Chairman of the Commission, the Beauharnois Company stated that it would supply on the same terms and conditions as the Gatineau Company, but in the negotiations, the representatives of the Beauharnois Company definitely refused any concessions in respect to future requirements, stating that any equipment, the output of which the Commission did not immediately order and pay for, would be changed from 25 cycle to 60 cycle. In addition to this, the Beau-

harnois Company specifically reserved in its offer any rights it might have in respect to its former contract with the Commission. In other words, its offer was to sell power, and sue at the same time.

Nor was there any provision in the Beauharnois offer for the additional line losses and the cost of line maintenance involved in the transmission of power from the Beauharnois plant to the Gatineau line. This is a distance of some 101 miles. Physical features are against the bringing of power to Toronto from a plant within 25 miles of the City of Montreal. The Commission has a single circuit line from the inter-provincial boundary where it meets with the Beauharnois lines near the St. Lawrence River. This line extends for a distance of some 75 miles till it forms a junction with the Maclaren lines at the mouth of the Lievre River, and from there goes on to Chats Falls. From Chats Falls the power is then transmitted for something over 200 miles to Toronto. The carry is thus 301 miles, and the capacity of the line is at maximum, 150,000 h.p. The former Commission planned the construction of a new steel tower high tension transmission line from the Beauharnois plant to the City of Toronto, at a cost variously estimated at from eighteen to twenty million dollars. The present Commission has no intention of entering upon any capital expenditure of that amount, in order to make available in Toronto power, the natural market for which is the Cityof Montreal. As the Beauharnois Company has now issued a writ and commenced action against the Commission, no further comment is necessary in this connection.

A Tremendous Saving to System's Finances

May I now endeavour to summarize what these new agreements mean, in actual finances, to the Niagara System. The Commisson has actually been billed for power from the four Quebec companies, for the year ending the 31st of October, 1935, the sum of $7,936,892.70, for deliveries amounting at the end of the year to 619,000 h.p. Next year we would have paid to these same companies $9,517,500.00 for a maximum of 706,000 h.p., at $15.00 per h.p. As already stated, our full supply is 140,000 h.p., with a reserve sufficient for some years to come of 130,000 h.p., and this is provided at a cost of $3,236,810.26, including all charges under the old contracts from the 31st of October until the 6th of December, 1935, when the former contracts were cancelled. It will thus be observed that the saving in power purchased for this year is $6,280,689.74.

In the year 1937, deliveries would have been completed under the old contracts for the full year, and the cost of the purchased power from the four Quebec companies would have amounted to the appalling sum of $10,965,000 per year. In actual fact and notwithstanding some increases in demand, we will, in that year, on the basis of the new contract, pay the sum of $2,750,000, a saving in the cost of power purchased of $8,214,500.

Monthly Power Bills Illustrate Big Saving

A graphic way to illustrate the difference between the actual cost of power under the new agreements and what it would have been under the old agreements, is to compare the actual

payments for the current month of February 1936, with what would have been the cost had cancellation not taken place.

The gross charge for the purchase of power from the East this current month is $282,333.34. Had the old contracts not been cancelled, the charge would have been $773,750. That is to say, we actually paid $491,-416.66 less than we would have paid under the old agreements.

But it must be noted that included in the payment actually made is the cost of 100,000 h.p. used at Thorold for the generation of steam. This commitment terminates on May 1st next, so that there will be struck from the payment of $282,333.34, the sum of $90,479.17, the cost of the steam power, reducing the payment for May, 1936, to $191,854.17. This is a little less than 25 per cent. of what we would have paid under the old contract. This is a saving of $581,895.83. The saving alone is three times the amount we still pay.

A saving of half a million dollars a month is startling, and it will continue and, in fact, will increase in subsequent years, due to the fact that deliveries under the old contracts are not yet complete.

Owing to anticipated increases in demands by the Commission's customers, it is expected that the cost of power from the Quebec companies will amount in 1938 to $3,245,000.00, a saving of $7,720,000.00, and in 1939 to $3,707,500.00, a saving of $7,257,-500.00. For the four years from 1936 to 1939 inclusive, our reductions in power costs as a result of the new agreements will amount to $29,472,-689.74. We have paid to the power companies in gross amounts from the year 1928 to the year 1935 inclusive, the sum of $33,652,337.51, so that our saving in power costs during the next four years is thus approximately within $4,000,000 of the total gross amounts paid to the four companies since the first horse-power arrived from the earliest Gatineau contract.

Reduced Rates Promised In Substantial Amounts

In view of these sensational cuts in the cost of power, the question will naturally arise as to what benefit may be expected by the Commission's customers. The Commission has not been unmindful of the future, and during the past year has had prepared at considerable expense a very complete analysis of the power loads of Ontario, so that such steps may be taken to protect its requirements as circumstances appear to warrant. At best, however, any calculation as to future growth is a matter of prophesy, or, shall I say, opinion. No one can look far into the future, but this seems clear beyond all peradventure, that the Commission will in the very near future be in a position to announce reductions in its charges for power to the municipalities, in most substantial amounts. In this connection may I give the positive assurance that it is the policy of this Government to hand on to the power-users of our System such benefits as good management may warrant, and its courageous battle against the excessive and unjustified exactions from the System may have secured.

Ontario Should Control Its Sources of Power

I should not close my report of the year's accomplishments in the Niagara

System without some reference to the Commission's policy with regard to future power requirements. The experience of the last five years, and particularly that of the period in which the present Commission has held office, is proof beyond peradventure of the inadvisability of permitting the power requirements of the people of this Province to depend in any large measure upon supplies of energy from sources in private control, and still more clear is the experience as to the danger of depending for our power needs upon private companies, subject to the legislative jurisdiction of any other province. There can be little objection to the purchase of moderate quantities which, were they at any time discontinued, would not result in a major disaster to the Hydro System and its customers, but to tie the System to supplies from beyond our borders in such large amounts that they cannot be readily replaced is to accept risks which are inadvisable and unnecessary. It is to lay the fires of discord and ill will, and to invite disaster. Never again shall the Hydro Commission or the Province of Ontario permit its contracts for the purchase of power to be used by promoters as the basis for sales of stocks and bonds to the investing public. From now on, the people of this Province should depend upon their own ability to produce and distribute. The principle of public ownership shall be extended in Hydro matters and tenaciously observed, and above all things, Ontario must in the future own and control the sources as well as the distributing systems for its supply of power.

Long Transmission Lines Mean Heavy Lines Losses

In this connection it is interesting to note the actual conditions existing at the Niagara Cataract. Gatineau, be it observed, is 260 miles from the City of Toronto. Niagara Falls is less than 80 miles distant, and the Niagara plants are located in the very centre of an industrial community. How important is this matter of location is indicated in the experience of the last year. Much has been said of the efficiency of the 220,000 volt transmission line from Gatineau to Toronto, and some calculations have been made public as to the amount of the line losses in electric energy, by reason of leakage and resistance. Experience is an apt teacher and the reductions in the supply during this year, from the Quebec plants, and the substitution of increased loads from Niagara have taught us much. Our actual practice has demonstrated that our line losses since the cutting off of the Eastern power and the substitution of Niagara power have been 26,000 h.p. less than they were under former conditions. At $15.00 per h.p. this is a saving on line losses alone, by reason of our present arrangements of $390,000 per year.

Policy of Commission is "Back to Niagara"

The Commission owns and operates three generating plants on the Niagara River. Two are at Niagara Falls and the third at Queenston. What is known as the Toronto plant was that which was taken over from the Toronto Power Company in the year 1920, and is situate above the Falls. Its efficiency is only 9.5 h.p. per cu. foot per second of water used. What is known as the Ontario plant was

purchased by the Commission from the Ontario Power Company in the year 1916, and is situate in the gorge immediately below the Cataract. It has an efficiency of 17 h.p. for each cubic foot per second of water used. The third plant is that which was constructed by the Commission at Queenston, and is fed by water conveyed from the Niagara River via the Chippawa Canal. Under normal conditions its efficiency is 29.6 h.p., or very nearly 30 h.p. for each cubic foot per second of water used. From these figures it is quite obvious that the efficiency of the Toronto plant is very low, being somewhat less than ⅓ per second foot of that at Queenston. The Ontario plant is better, but is still somewhat less than ⅔ of that of the Queenston plant. The opportunity for an engineering and construction program at Niagara is quite apparent from these figures, and in addition, considerable quantities of water may still be diverted into power channels without endangering the scenic beauty of the Falls. The policy of this Government is to free itself as rapidly as reasonably possible from entangling alliances with private power companies, and the policy of the Hydro Commission is "Back to Niagara."

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EASTERN ONTARIO SYSTEM

A striking feature of the history of the past year in the Eastern System has been the marked increase in the growth of load, and a surplus of more than $100,000.00 in excess of the comfortable surplus of last year. This has been most satisfactory, but the most outstanding achievements in the Eastern District for the year that has just closed has been the making available of the idle capacity of the Commission's plants on the Madawaska River—the installation of a frequency changer connecting the 60-cycle load of that district with the 25-cycle load of the Niagara District, and the cancellation of the former contract with the Gatineau Power Co. and the substitution of a new contract based upon the Commission's actual requirements of electrical energy, at a considerably reduced price. In the matter of achievements, this is the banner year in the history of the Eastern District.

Increased Revenue and Lower Operating Cost

In the matter of growth, it is interesting to note that the peak load of primary power in 1934 which occurred in December, was 96,783 h.p., but the peak this year, 1935, was 107,185 h.p. —an increase of 10,402 h.p., or 10.74 per cent. over last year. In this System, as in the Niagara System, good management is evidenced in increased revenue on the one hand, and decreased expenses on the other hand. The revenue from the Eastern System in the three years just passed has been as follows:

1933 .... $2,643,702.77.
1934 .... 2,787,754.34.
1935 .... 2,864,646.80.

That is to say, the revenue of the last year was $76,892.46 greater than that of 1934, and $220,944.03 in excess of that of 1933.

Notwithstanding a considerable growth in the cost of purchased power, the expenses have decreased to the point that our surplus has substantially increased. In 1933 we paid for purchased power $777,050.62—in 1934 we paid $833,980.26, and in 1935 we

paid $847,560.25—an increase over the figures of 1933 of $70,509.63, in the cost of power. Offsetting this growth in the cost of power, however, has been a steady decrease in the expenses of the System, operation, interest, and reserves included. The figures are as follows:

1933	$1,830,239.09
1934	1,820,035.00
1935	1,775,995.53.

or a decrease in expenses for 1935 over 1933 of $54,243.56.

The result of this favourable trend in the relationship of expense as compared with revenue, is to be found concisely expressed in the System's increasing surplus. There have been practically no increases in rates in this System during these years, and there have been some decreases, but, notwithstanding, the surpluses for the three years have been as follows:

1933	$ 36,413.06.
1934	133,739,08.
1935	241,091.02.

Nor have these surpluses been achieved at any cost to capital account. Reserves have been faithfully accumulated on the basis of the Commission's highest standard of practice, so that our combined reserves have now grown to $6,674,597.00.

Madawaska Capacity Now Made Available

I have already spoken of the engineering achievement which made available to the Commission's entire System the idle capacity of the Commission's plants on the Madawaska River. It will be recollected that shortly after the death of Sir Adam Beck on the 15th of August, 1925, the Commission's former policy of public ownership was abandoned, and on the 28th of December, 1927, the Commission entered into a contract with the Gatineau Power Company for the purchase of 100,000 h.p. of 60-cycle power to be generated on the Gatineau River. Under the former policy the Commission had abandoned the purchase of power as rapidly as possible, and was extending its generating resources within its own control by the construction and acquisition of plants in the Trent Valley and on other eastern rivers. The purchase from the Gatineau Power Co. was not greatly in excess of the System's requirements as they could be foreseen at that time, so that this purchase may be excused, though it can scarcely be justified in view of a number of potential developments which were available within the district.

Modest Capital Outlay Adds Power Resources

Having supplied their requirements, however, the Commission proceeded to the purchase in 1929 from the O'Brien interests of two plants on the Madawaska River, one at Galetta with a capacity of 1,100 h.p., and the other at Calabogie with a capacity of 5,400 h.p.—a total of 6,500 h.p., together with an undeveloped capacity on the Madawaska River of approximately 85,000 h.p. The purchase price was $1,800,000 which has carried an interest charge during the years that have followed of over $100,000. per year. It was in connection with this purchase that a payment of $50,000. was made to a promoter named John Aird, Jr., for no apparent consideration. There has been a total loss in interest charges to date of approximately $600,000.00. During these intervening years the Galetta

plant has been closed, and the capacity of the two plants has been used to less than ⅓ of the 6,500 h.p. available. The reason for this non-usage of available power lay in the fact that the two plants have not been connected with the general Eastern System, and have been restricted to the supply of a comparatively small local load of less than 2,000 h.p. in the immediate district. During the past summer the Commission has connected the Madawaska local system to the general Eastern District by the building of a 33,000 volt transmission line from Galetta to Smiths Falls. The cost of this transmission line and transformer equipment has been approximately $120,-500. The Commission has thus added to its Eastern System resources approximately 4,000 h.p., available at all times for peak purposes and for energy on a high load factor during periods of normal stream flow. Aside from the investment in the plant which had already been made, this is a capital outlay of only approximately $30.00 per h.p.

New Frequency Changer Connects Two Systems

I have already recounted the events which led up to the installation of a frequency changer at Chats Falls to connect the 60-cycle Eastern System with the 25-cycle Niagara System. The advantage of such an installation, which makes possible the delivery of a surplus in the Niagara District for use as occasion requires on the Eastern lines, needs only to be mentioned to be appreciated. It has overcome in a large measure the disadvantage of the lack of uniformity in generating equipment in the two systems.

Beneficial as have been the developments I have mentioned, they are exceeded in importance by the cancellation of the former contract with the Gatineau Power Company, and the closing of a settlement agreement upon a considerably more advantageous basis.

Commitments and Price Both Greatly Reduced

The former agreement completed in 1927 obligated the Eastern System to accept deliveries from the Gatineau Company of an amount of power, increasing at the rate of 6,000 h.p. per year, quite irrespective of whether such an amount of electrical energy was required or could be used. On the 1st of October, 1935, deliveries under this old contract had grown to 48,000 h.p., and on the 1st of October, 1936, this amount would have been increased to 54,000 h.p., and the next year to 60,000 h.p. As a matter of fact, the System's actual requirements this year were not in excess of 42,000 h.p. notwithstanding the record growth which I have mentioned from a peak load of 96,783 h.p. in 1934, to 107,185 h.p. in December of 1935.

The new agreement is for such power as the Commission may require, with a minimum of 42,000 h.p., and a reserve up to 60,000 h.p.

The price per h.p. fixed in the former contract was approximately $14.50 per h.p. The price under the new agreement is $12.50 per h.p. for such power as is delivered and used, and $10.00 per h.p. for 9,000 h.p. which is reserved as an immediate stand-by in event of accident to the Commission's equipment, and $1.75 per h.p. for the remaining 9,000 h.p. of general reserve, it being provided

that additional requirements of the Commission shall be taken first from the general reserve, and then from the stand-by, and when both of these are exhausted so that the full 60,000 h.p. is used, the price is the flat amount of $12.50 per h.p.

New Agreements have More Acceptable Terms

Under the old agreement the Company was obligated to provide 82,000,000,000 cubic feet of storage on the Gatineau River, in order to maintain the stream flow necessary to assure a constant delivery of power during all seasons of the year. Under the new agreement the water storage capacity is to be 140,000,000,000 cubic feet. Under the old agreement, payment was to be made in lawful money of Canada or in gold. Under the new agreement, payments are to be made in lawful money of Canada at Toronto.

Delivery under the old contract was to be at Smiths Falls, which was later changed to the inter-provincial boundary, with an allowance for the difference in cost. Under the new agreement, the delivery is at the inter-provincial boundary.

The old contract was for a term of 40 years from the 1st of October, 1928, while the new contract runs for a firm period of 10 years from the 1st of November, 1935, terminable then or thereafter on two years' notice. The new contract is to be construed according to the laws of the Province of Ontario. The old contract was silent upon this point.

Under the old contract the Gatineau Power Co. agreed to delivery within the Province of Ontario, involving construction of works connecting one province with another province and extending beyond the limits of a province—something beyond its legal capacity. Under the new contract the power is furnished by the Gatineau Power Co., a Quebec incorporation, and is transmitted across the inter-provincial boundary by plant and equipment owned by the Gatineau Transmission Co., a company incorporated under the laws of the Dominion of Canada, and having in consequence the legal capacity to perform this service.

Quebec Cannot Levy on Ontario Power Users

Under the old agreement any increase in taxes, charges, rentals or royalties, or any new charges of the kind which the Dominion or the Province of Quebec might impose upon the Company so as thereby to increase the cost of power to the Company were to be paid by the Hydro-Electric Power Commission of Ontario. Under the new agreement there is no such provision. The Company pays its own taxes, charges, rentals and royalties as may be levied by the Province of Quebec or the Dominion Government, and the Hydro-Electric Power Commission pays taxes only in regard to the 10-feet of transmission line, the property of the Transmission Company, which lies within the Province of Ontario.

As I stated previously, under the new agreement not only has the amount of power to be paid for been reduced, but the price also has been altered to $12.50 per h.p. An immediate stand-by of 9,000 h.p. has also been provided at $10.00 per h.p., on terms permitting its use in event of failure of the Commission's supply by reason of accident, or need for repair,

to the Commission's plant and equipment. A further reserve of 9,000 h.p. has been secured at $1.75 per h.p.

A comparison of rates under such circumstances is both difficult and complicated. The reduction in cost of power to the Eastern System involved in the change of agreement can be most clearly and definitely exhibited in gross figures.

Better Terms Reflected in Gross Power Bills

It will be observed that the growth in load last year amounted to 10,402 h.p. This, however, is much in excess of growth in former years, and is due in the main to increased demand by General Motors at Oshawa, and the Howard Smith Company at Cornwall. The growth since 1928 has averaged, this year included, only 3,702 h.p. per year. An anticipated growth of 6,000 h.p. per year for the next two or three years is probably, therefore, an outside estimate. The present surplus in the Eastern District is ample to supply the Commission's needs for the current year, so that no further orders need be placed.

Under the old contract we would this year have paid to the Gatineau Company the sum of $649,312.50. Under the new contract we will pay the sum of $630,750.00—a saving for 1935 of $18,562.50.

Under the old contract we would have paid in 1937 the sum of $737,062.50. On the estimated basis of an increase in demand of 6,000 h.p. during the full year of 1937 we will pay under the new contract, $695,250, a net saving for 1937 of $41,812.50.

Substantial Sum Saved During Ten Year Term

Under the old contract we would have paid in 1938 the sum of $817,500.00. On the basis of a further contract demand for the year of 6,000 h.p., we will pay to the Gatineau Company under the new agreement, $735,000.00, a net saving for 1938 of $82,500.00. By 1939, on the estimated basis of growth, the Commission will have accepted the full amount of 60,000 h.p. Under the old contract we would have paid $817,500.00 for this amount of power. Under the new contract, at $12.50 per h.p. we will pay $750,000.00, a saving in 1939 of $67,500.00, and a similar saving year by year until the contract term has expired. This is a total saving during the 10-year term of the contract, of $615,375.00, in the cost of power for the Eastern System.

When one turns towards the future, two enquiries naturally arise. What will be the cost of power under the new arrangement, and what are the Commission's resources should the growth in demand continue beyond the 60,000 h.p. now provided. As to the first question, one has but to note the surplus last year of $241,000.00, and to bear in mind what I have said with respect to the prospect of savings under the new contract, to appreciate that the Commission will very shortly be in a position to grant a substantial reduction in the cost of its power to our municipal customers.

Ample Power Supplies at Much Lower Prices

With regard to the second question, as to the Commission's resources to meet the demand of future growth, I need but mention the possibilities that are suggested in the frequency changer between the Niagara System and the Eastern System with a capacity of

60,000 h.p., and to this is to be added the 85,000 h.p. of undeveloped capacity on the Madawaska River for which we have already paid the exhorbitant price of $1,800,000 to the O'Brien interests, and to this is to be added further capacity available on the Mississippi River and the Trent watershed, to say nothing of such supplies as may be available from the Ottawa and the St. Lawrence River.

The home-owners and industrialists of the Eastern System may look forward to a future of ample power supply, at a price substantially lower than that charged in the immediate past.

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GEORGIAN BAY SYSTEM

The operation of the Georgian Bay System has been uneventful, and its financial progress has been so normal and satisfactory that my report on its management results for the last year may be given in very few words.

Power Purchased From Niagara System

The Georgian Bay System fortunately escaped the blight of purchased power contracts. There is no very obvious reason for this oversight, unless perchance it was thought that the bird was not quite yet ready for the plucking. At all events it escaped, and is served by eleven generating plants, having a normal operating capacity of 26,100 h.p., all publicly owned. Its owned and controlled supply is supplemented by the purchase of a maximum of 8,000 h.p. of electrical power on a kilowatt-hour basis from the Niagara System. It thus obtains its outside supplies under an arrangement in marked contrast to the former agreements with the Eastern power companies, under which the Niagara System has so severely suffered. It accepts what it wants, and pays per kilowatt-hour for what it gets. For the year ending the 31st of October 1933, the Commission's total expenses were $977,789.93, and its total revenue was $1,033,-863.50, showing a surplus of $55,-972.57. In 1934 expenses were slightly decreased and revenue was slightly increased, so that the System showed a surplus of $95,695.11.

In 1935 the total expenses of the System were $908,902.77, a decrease over 1933 of $68,988.16. The total revenue for the year 1935 was $1,004,-226.63, leaving a surplus of $95,323.85.

The fact that the present Commission in each of its annual reports of 1934 and 1935 is able to announce a surplus of nearly $100,000 a year, together with the fact that the physical operation of the System has been so uneventful that there is nothing of note to be mentioned, is sufficient indication of satisfactory good management.

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THUNDER BAY SYSTEM

The outstanding feature of the year's financial operations in the Thunder Bay System has been the conversion of the heavy deficit of past years into a comfortable surplus of this year. This is the first time that the Commission has been out of the "red" since the construction of the Commission's plant at Alexander Landing on the Nipigon River, in 1930. Nearly all the power generated by the Commission's plants in the District of Thunder Bay is used by the Cities of Port Arthur and Fort William—adjacent rural and mining districts, and the Village of Nipigon.

During the early years of Hydro's history, power was bought from the Kaministiquia Power Company, from its plant at Kakabeka Falls. But in 1918 the Commission undertook a development at Cameron Falls on the Nipigon River, with an installed capacity of 75,000 h.p., and, in what now appears to be an excessive enthusiasm, a second plant was built at Alexander Landing on the Nipigon River. It was completed in 1931, with an installed capacity of 54,000 h.p. These two plants have an installed capacity of 129,000 h.p., but the load on the System was at that time, however, only 90,000 h.p. The Commission has, in consequence, suffered a series of annual losses up to the present time—the burden of which has fallen in the main upon the cities of Port Arthur and Fort William.

First Surplus Shown During Many Years

In 1933 the System's deficit was $95,683.25. During the succeeding year in which the present Commission managed the property from the 11th of July, to the 31st of October, the deficit was reduced to $53,745.45, while this year, ending 31st of October, 1935, the System shows its first surplus for many years, amounting to $3,721.20, and is no longer a burden upon the domestic power users of the towns at the Head of the Lakes. How welcome will be this news to Port Arthur and Fort William may be judged from the fact that the total charges to the municipalities over the total of the monthly bills rendered since 1930, has amounted to $324,233.75. In addition to these thirteenth bills, there has been deducted from the System's reserves the sum of $330,327.06 to meet the balance of the deficits.

This satisfactory change in the financial showing of the System is in part the result of mining activities taking place on the north shore of Lake Superior, in the Sturgeon River District. The Northern Empire Mines, and the Little Long Lac Mines built their own transmission line in 1933, and last year absorbed approximately 2,500 h.p.

Hydro's Contribution to Industrial Activity

There are three great modern pulp and paper mills in this district—two at Port Arthur, and one at Fort William. During recent years these mills have been closed for a portion of each year, or have been running at reduced capacity. There has, however, been a revival in the pulp and paper business of this locality. Three years ago the Commission entered into agreements with the pulp and paper companies for the sale of at-will power, at approximately $4.00 per h.p., for use in the generation of steam. In consequence, the Commission's generating plants have been operating to their normal capacity, and the System's losses were accordingly due to low rates. The problem therefore, which confronted the Commission was to secure the sale of an increasing amount of primary power at normal prices, and a consequent reduction in the amount sold for the generation of steam. During the past year the Commission's efforts in this respect have met with considerable success, as is evidenced by a surplus in place of a deficit, and the Commission has not only ceased the depletion of its reserves and the

charging of heavy losses to the municipalities in thirteenth bills, but is also in a position to offer more favourable rates to the important pulp and paper industry at the Twin Cities. The pulp and paper mills are now paying for firm power from $20.00 to $21.50 per h.p., and a proposal is now under consideration to reduce this price to $18.00 per h.p., on the basis of increased takings. If this can be accomplished, it will result in considerably increased industrial activity and in employment, as well as financial benefit to both the System and to the municipalities.

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MANITOULIN RURAL POWER DISTRICT

Electrical light and power service on Manitoulin Island is the result of the application of rural power principles to the Town of Gore Bay and the Hamlet of Mindemoya. By special Act of this Legislature the Government has paid 50 per cent. of the cost of the installation throughout the entire System, including both town and rural districts. Power is purchased from the Manitoulin Pulp Company at $25.00 per h.p., and distributed at great benefit to the local residents, at a cost to the Government of something less than $60,000.

One hundred and seventy-six customers are served, and the average demand this year was 101 h.p. The striking feature of the Commission's management this year of the Manitoulin Rural Power District consists in a reduction of former deficits to almost the vanishing point. In 1933 the deficit was $1,383.84, for that portion of the year in which the System was in operation. For the full year of 1934 it was $2,023.28, and this year, the deficit, owing to a reduction in expenses of over $1,000, together with some increases in revenue received, has been reduced to the small amount of $638.42. This deficit is so small as to be unimportant, particularly in view of the fact that sinking fund, renewals and contingencies reserves have been provided, and it may confidently be expected that next year a surplus will be reported.

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RURAL POWER DISTRICTS

One of the outstanding achievements of the Commission during the past year has been the expansion of its electrical services in the rural power districts. It has not only extended its lines by a greater number of miles than in any year since the commencement of the depression in 1929, but it has also reduced the cost of its services, and has inaugurated a policy of giving free power for certain purposes. In no section of the community is electrical service of greater importance or more appreciated than in the farming communities, and in no place in Canada or perhaps the continent, is it sold in so great an area at so low a price, and no Government of which I have knowledge contributes so handsomely to the cost of installation. The Ontario Government contributes 50 per cent. of the cost of both primary and secondary transmission lines and secondary equipment for the purpose of distributing light and power to rural citizens.

The total expenditure on the distribution systems in the rural power districts of Ontario to the 31st of October, 1935, is over $19,000,000, and of this amount the Ontario

Government has contributed by way of bonus, $9,500,000. During the year 1935, the Commission has constructed and under construction, 541.45 miles of rural distribution lines, giving service to 3,962 customers. Our total estimated expenditure for 1935 is $1,423,745.00, to which the Province will contribute by way of bonus $707,882.00. The Commission has now 67,802 farm and hamlet consumers served by 9,976 miles of rural distribution lines. The Commission is planning the construction of 838 miles of line, to serve approximately 6,400 additional consumers this year, with a total expenditure of approximately $2,000,000, to which the Province will contribute $1,000,000. During previous years the Commission has set up reserves for contingencies, which have now amounted to over $1,000,000 for all Systems. In view of the distribution of rural lines over wide territory, $1,000,000. is sufficient in a $20,000,-000. investment, as an insurance against unforeseen and unforeseeable contingencies, and betterment of the fund by way of interest earnings is sufficient to meet ordinary charges on this account. Under these circumstances, the Commission decided to discontinue charges against rural customers on this account. Experience had also demonstrated that the reserves on account of renewals were in excess of the annual charges on this account and accordingly, they have been reduced from 2 to 1.75 per cent. on the total capital investment.

The result of these changes has been a substantial reduction in maximum service charges to rural customers—a most welcome relief in view of economic conditions in our farming districts. This is a reduction of approximately 10 per cent. in maximum service charges to rural customers in hamlets and on small farms served by the Commission, and a 20 per cent. reduction to standard and large farms, and other consumers requiring heavier than ordinary loads. The total saving per annum to rural consumers on account of this reduction is estimated to amount to $225,000.00, beginning in 1936.

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NORTHERN ONTARIO PROPERTIES

The success of the present Hydro management in turning deficits into surpluses, or increasing surpluses in every division of the Commission's owned systems has also characterized its trusteeship of the Northern Ontario Properties. The publicly-owned electrical developments of Northern Ontario are in a different financial responsibility from those of the other Systems. In other parts of the Province the plants are vested in the Hydro-Electric Power Commission, and supply power to municipally-owned Systems on a cost basis, and, as well, to individual customers. In Northern Ontario, however, the properties are owned by the Provincial Government, and are operated by the Hydro-Electric Power Commission on the Government's financial responsibility.

In Northern Ontario the Government owns and operates, outside of the Abitibi plant, nine generating stations, with a capacity of 136,300 h.p. The Northern territory is divided, for electrical purposes, into six

separate districts or systems. They are as follows:

Abitibi,	Espanola,
Nipissing,	Albany River,
Wahnapitae,	Red Lake.

It will be convenient to consider the finances of the Northern Ontario Properties in two divisions. The first, Abitibi, and next, all divisions other than Abitibi, and I will commence with the latter.

In 1934 the divisions other than Abitibi showed a revenue as of the 31st of October, of $675,761.69, and a total expense of $534,955.55, being a surplus over cost of operation, maintenance, interest, renewals, obsolescence and contingencies, of $140,-806.15—a very creditable showing.

During the year 1935, due to increased demand for power, the revenue of the districts exclusive of Abitibi have shown satisfactory growth. To the 31st of October, 1935, the revenue was $754,313.60, and the total expenses were $627,271.83, leaving a surplus of $127,041.77.

The Commission is at the present time installing, or planning the installation of, additional units on both the Albany River and the English River. During the year 1935, the Commission commenced the installation of an additional generating unit at Rat Rapids on the Albany River in the Lake St. Joseph district, in order to supply the requirements of the Pickle Crow and Central Patricia mining enterprises. The cost of the plant already installed was $420,000. The cost of a new installation will be approximately $300,000. The rates to be charged are calculated on a basis of the retirement of the entire capital investment within a period of 10 years from completion.

On the English River the Commission's unit of 5,000 h.p. capacity at Ear Falls has supplied power to the Red Lake District. It is now almost fully loaded, and the mining development in the District is such as to require additional generating capacity. Contracts are now being negotiated with several mining companies which will, when completed, result in the installation of a second unit of 5,000 h.p., at a cost of approximately $500,000. The revenue from those proposed contracts will be sufficient at the rates to be charged, to retire the entire capital investment in this plant within a period of 15 years from the date of completion.

ABITIBI DISTRICT

The growth of demand for power in the Abitibi District during the past year has been satisfactory, though the Commission is still obliged to report a deficit, which is, fortunately, considerably reduced over that of last year. During the past year the Commission has installed all units of the Abitibi Canyon plant—five in all, with a capacity of 66,000 h.p. each, making a total installed generating capacity of 330,000 h.p.

Two of these units had been installed when the present Commission took office, and the other three were in storage and were depreciating, and the manufacturing companies were demanding payment of their accounts. For these reasons, and because of the past and prospective growth in demand for power, the Commission determined to complete the Abitibi Canyon plant. Settlement was effec-

ted of all outstanding claims by the various contractors and supply houses on a basis of 70 per cent of their finally-adjusted accounts. The total amount involved in this settlement was the considerable sum of $4,835,610.88, and the final cost of the Abitibi development, with its generating plant and transmission system complete is $25,022,972.19.

Canyon Power Plant Not Subject of Criticism

In a recent speech in this House, the Member for South York and former Minister of Highways declared that before four years are up since the last election, "Abitibi will stand like a beacon as one of the assets of this Province." One cannot be but captivated by the optimism of the honourable gentleman, who can discern the beacon light shining through the fog of public condemnation which enshrouded his late colleagues in the former Government, as a result of their record in connection with the Abitibi Canyon development, but unfortunately, the honourable gentleman's "beacon light" is a will-o-the-wisp.

Abitibi Alienated Into Private Control

The Member for South York has referred to this enterprise as the "much-maligned Abitibi power development," but, as a matter of fact, no one has uttered a derogatory word towards that magnificent source of power on the Abitibi River, nor has anyone on this side of the House or in the country maligned the great power plant located at the Canyon, or doubted the value of its service to the mining and other communities of the North. What has been criticized was the alienation of this power into private hands in 1926, and the part which the former Government played in the stock-jobbing operations of its friends the promoters, and particularly of the part which the former Prime Minister played in his personal capacity as an investor in the bonds of a public service corporation having dealings with his Government, and finally, his misuse of public funds to avert a private financial catastrophe to himself and his friends, and to the company of which he was a director.

Public Ownership Has Reduced Power Costs

The honourable gentlemen opposite will find cold comfort in their attempt to confuse the record of the present Commission's achievements in Northern Ontario with the betrayal by the former Government of the principle of public ownership—its questionable dealings with the Abitibi promoters, and the actions of the Members of the former administration in the use of the public exchequer to protect their own and other private interests. In the Abitibi fiasco as in other Hydro matters, the honourable gentleman's "beacon" is under a bushel. Had the intentions of the honourable gentlemen opposite not been frustrated by the unexpected insolvency of the Ontario Power Service Corporation and the Abitibi Power and Paper Company, this "beacon asset" of the Abitibi Canyon development would have been a bright and shining light to the Abitibi promoters, and the mining districts of the North would have been blighted by another private power monopoly similar to the Northern Ontario Power Company, which has for many years imposed contracts on mining companies for the life of

the mine at rates based on all the traffic will bear. It was the beacon of public ownership that pierced the gloom of $50.00 and $60.00 h.p. to the mining communities of the North, and by its competition has this year reduced rates to as low as $22.50 per h.p., and has conferred upon the mining industry the inestimable benefit of cheap and abundant electrical power.

Gave the Canyon Power into Private Ownership

In his confession to this Legislature on the 6th of April, 1933, the then Prime Minister and present Leader of the Conservative Opposition stated that on November 11th, 1926, water-power lease No. 26 was issued to the Hudson Bay Power Co., Ltd., a subsidiary of the Abitibi Power and Paper Company Ltd., granting free of purchase price the water-power known as the Abitibi Canyon. The lease was granted on the recommendation of the Hon. Geo. S. Henry, Minister of Lands and Forests, and called for the filing of plans within eighteen months from the date of the lease. The conditions of the lease were not fulfilled, and there is correspondence on file in the office of the Hydro-Electric Power Commission, in which Mr. Magrath, then Chairman of the Commission, made an earnest attempt to induce the then Prime Minister, Hon. G. Howard Ferguson, to develop the water-powers of the North on a public ownership basis. Writing to Mr. Ferguson on the 21st of June, 1928, Mr. Magrath says:

"If private capital can develop power sites in Northern Ontario and continue to supply the people concerned, there is no occasion to worry about the future. I am fairly well convinced, however, that that will not be the outcome, because as already stated, the Commission has been faced with the issue in some of the existing municipalities in the North.

"The Government should set apart for Hydro a few key power sites, which would enable the Commission in the future to throw power into almost any section in the Northern country, as a means of controlling the situation."

Again on the 29th of August, 1928, Mr. Magrath wrote:

"It seems to me then, there is only one method of procedure, and that is for the Government itself to develop from this day forward, all power sites in that part of the Province. It is very generally accepted that Northern Ontario has vast undeveloped wealth, and hydro-electric power will play an important part in that development.

"No province in Canada is in the same favourable position as Ontario, because you have at hand an organization capable of looking after not only the development, but the distribution of power."

Were Fairy God-Fathers to Abitibi Promotors

Nothing was done by the private owners of the Abitibi natural resources, and in spite of this admonition, and on the 9th of July, 1930, the lease was amended by Order-in-Council, on the recommendation of the Prime Minister, to give away this property for the second time. Not only was the honourable gentleman's "Beacon asset" given away by the Government of Ontario, but the Hydro Commission agreed to purchase 100,000 h.p. per year at $13.00 per h.p., at an annual charge of $1,300,000, and the Government of Ontario guaranteed the Hydro Commission from its liability to loss by reason of its inability to secure customers. Aside from such resale as there might be to the development company's associates in the Abitibi Power and Paper combination, there was just one purchaser in sight—the International Nickel Company

Ltd., for 16,000 h.p., and the Hydro Commission agreed to the construction of a transmission line from a point near Cochrane to Sudbury, for 189 miles through the virgin forest.

With a gift in hand of the finest waterpower in the North, and a Government guarantee of $1,300,000.00 per year, together with the public construction of a high tension transmission line and distributing system, the Company proceeded to sell its bonds back to the public. The bonds were sold to the very firm of underwriters whom the leader of the Opposition had the fortitude to criticize during the present Session of the Legislature, for 89.22 and sold for 94.22—an advance of an even five points. The issue of $20,000,000.00 netted approximately $18,000,000.00 and the bonding company made a cool $1,000,000.00.

It was on this point that the then Prime Minister, now Leader of His Majesty's Loyal Opposition, and one of the Members of the Hydro Commission invested their private funds, and the monies of the companies which they directed, in this company's bonds. Let there be no misunderstanding of this matter. There is no maligning of the Abitibi power development when the gentlemen on this side of the House denounce that act as a betrayal of public trust, and a violation of the fundamental principle of public propriety.

WHO SUPS WITH THE DEVIL SHOULD HAVE LONG SPOON

The present Leader of the Opposition had forgotten the adage that "He who sups with the Devil should have a long spoon." The promoters had loaded their proposition to the point that they were unable to bring the plant to completion, and the Company defaulted in the payment of interest. The honourable gentlemen from East York admitted that the bonds had sold on the New York market as low as $30.00 each, and no doubt they would have gone lower still had it not been for the prospect of his Government's assistance, and yet on the 25th of June, 1932, the then Prime Minister announced the exchange of this bankrupt company's bonds for Hydro bonds, with a guarantee by the Government, on a basis of $90.00 per $100.00, and the Province was committed to an expenditure of $18,000,000.00 for the assets of a bankrupt company. It was not until some considerable time later that the Prime Minister was forced to confess from his place in this House that he was himself a holder of bonds in the Company—that he was a Director of a company with a large block of these bonds, and that one of the Hydro commissioners was financially interested both personally and as a share-holder and Director of a number of companies, and that he had concealed from his own colleagues that he was personally interested in a transaction involving the expenditure of millions of dollars of public funds, which as Prime Minister he had recommended.

Speaking in his place in the House during the current Session of this Legislature, the Honourable the Leader of the Opposition characterized me as the "evil genius of the present administration." Well, no one has ever charged him with being a genius of any kind, and I trust that no honourable gentleman on this side of the House

will ever be able to match him in this transaction, either in evil or in stupidity.

Hydro Has Contributed to Northern Activity

The gentlemen on this side of the House noted with pleasure the satisfaction expressed by the Members of the Opposition at the public service being rendered in the development of Northern Ontario mining properties by the publicly-owned and Commission operated Abitibi power development, and their approval of the Commission's efforts to rescue the Abitibi Canyon finances from the gloom in which they left them. The reduction in the price of power has made possible the exploitation of low-grade properties, and together with the advance in the value of gold, is the explanation of Ontario's great mining activity. The Commission's management of the Northern Hydro has been of signal benefit, not only to the North, but as well to the Province and the Dominion, and the enterprise which the Commission's activity has made possible, is one of the few bright spots in the Tory depression from which we have been suffering—but the task of rehabilitating the finances of the Northern Properties is one of no small magnitude.

Surpluses Wiped Out by Abitibi Deficits

As I have already stated, in the properties other than Abitibi, there was a surplus in 1934 of $140,806.14, and in 1935 of $127,041.67, but this most satisfactory surplus has been completely wiped out by the losses in the Abitibi System.

In 1934 the revenue of the Abitibi property amounted to $562,549.31, and its expenses, including renewals, but without contingencies or obsolescence, amounted to $1,041,109.52. That is to say, the revenue received was little more than fifty per cent. of the expenditure, without provision for obsolescence and contingencies. The actual deficit was $478,560.21. Thus a profit of $140,806.14 in the districts other than Abitibi was totally absorbed, and the Northern Properties as a whole showed a deficit of $337,754.07.

In 1935 this deficit has been more than cut in two. The revenue of the Abitibi property amounted this year to $943,997.53, and the expenses, without contingencies or obsolescence amounted to $1,215,502.95, leaving a deficit of $271,505.44. This deficit absorbed the surplus of $127,041.67 in the other districts, and left a loss over the entire Northern Properties of $144,463.77.

One must emphasize that in neither 1934 or 1935 has the very necessary item of sinking fund been included in these figures.

Lower rates for power in Northern Ontario has resulted in increased demand. In 1934 the Abitibi property supplied firm primary power to its customers to the amount of 31,501 h.p. In 1935 this demand was increased to 43,731 h.p.—an increase in a single year of 12,230 h.p. This increase is continuing, and the Commission looks forward to a balanced budget in the Abitibi District probly during the year of 1937.

Northern Properties Are Now Out of "Red"

And here perhaps may I be pardoned if I pause with some pride on the "piece de resistance" of this Northern story. In December of this

year in the combined Northern Districts, the Commission had a total revenue in excess over all expenses other than sinking fund, for the first time since the Canyon purchase was completed. The Northern properties are this year out of the red.

* * * *

CONCLUSION

Perhaps at this moment when everyone is happy with so satisfactory an announcement, I might take occasion to remark on the ruin which the Leader of the Opposition has discovered in the financial credit of the Hydro System. In this connection may I recall that on Thursday, the 20th of February, 1936, the Commission accepted a tender for the sale of $15,000,000.00 of bonds of the Hydro-Electric-Power Commission, guaranteed by the Ontario Government, at an interest cost of 2.58 per cent., the lowest rate achieved by any Hydro Commission at any time. They are payable in five years time. The next last transaction of a similar character was in December, 1934, when the Commission disposed of $10,000,000, eight-year Hydro bonds with a Government guarantee at an interest cost of 3.6 per cent. Good management on sound business principles—the courage to face facts and to correct absurdities, and the determination to resist unprincipled robbery does not destroy credit—it improves it. Business men will entrust their funds to those who have the ability and determination to be truly honest, while they shun alike the knave and the weakling. The first essential to improved Hydro credit was the shaking free of the "Old Man of the Sea" who was fastened on its back.

Increased Demand Will Follow Reduced Rates

Speaking in the House during this Session the Leader of the Opposition declared that the day would come when the Liberal administration would hang its head in shame in the face of a demand for all the power once purchased from Quebec. The honourable gentleman credits us with the ability to blush—a power which apparently he himself does not possess. In reply I say that there will be in all probability a considerable expansion in the demand for power, but that demand will result not from the policies which he would pursue, of loading the power-users with the cost of vast quantities of energy which cannot be used, but rather from the decreased prices which this Government promises to the people of Ontario, by reason of its refusal to buy power which it does not want. Reduction in rates will undoubtedly bring about increased use of power, and increased use will result in industrial activity and increased employment. As the demand grows, as we hope it will, the Commission will meet the requirements whatever they may be. Instead of hanging its head in shame as the gentlemen opposite are pleased to imagine, this Government will look the workers and industrialists of the Province in the eye, conscious of a Hydro enterprise whose finances are truly like the rock of Gibraltar, and whose service to the public has rendered an inestimable benefit to mankind.

THE BULLETIN

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Hydro Electric Range Campaign

April 15, 1936, Marks the Beginning of a New Drive on Electric Ranges in Hydro Municipalities

FOR the past year the Commission has been co-operating with Hydro Municipalities, manufacturers and dealers in an endeavor to increase the number of electric ranges sold to Hydro consumers, with very encouraging results. It has been decided to carry on the campaign for another year and an endeavor will be made to enlarge the scope of the campaign activities.

RESULTS OF LAST YEAR'S CAMPAIGN.

After a year's campaigning, several outstanding truths have manifested themselves:

1. Electric ranges will not sell themselves. Intensive selling effort must be exerted if any objective is to be reached.
2. Where the local Hydro system was aggressive, there were more ranges sold than where only an indifferent interest to range sales was shown.
3. Where Hydro Shops operated, a still greater impetus was given to range sales.
4. Where the local utility financed sales made by dealers, the dealers were more enthusiastic than ever before and a decided improvement was noted in their attitude toward the Hydro.
5. Where the local utility partially or entirely relieved prospective consumers of the burden of a new 3-wire service, the sale of ranges increased.
6. If a local system is anxious to increase range sales it must take the leading part in promoting such sales, by constant advertising and frequent stirring up of dealers, to keep them on their toes.

LOCAL POLICY.

In order to accomplish the desired results this year it has been decided that each municipality should establish a quota of the number of electric ranges to be sold by all parties during the next twelve months, and each municipality will be notified of its quota. Local promotional forces are

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Vol. XXIII No. 4
APRIL, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

asked to co-operate as far as possible to reach our objective.

In asking Hydro municipalities to co-operate in this effort several recommendations as to policy have been made. They are as follows:

Each municipality where possible should—

1. Finance the sales of ranges made by dealers for a period of from one to five years as may be found necessary.
2. Establish a financing rate as low as possible commensurate with the cost of funds and the terms offered by competing interests.
3. Install a 3-wire service and range wiring at no cost to the consumer as part of the local distributing system.
4. Establish a quota of at least 10 per cent. of the number of electric ranges now in use as an objective for 1936.
5. Establish an advertising fund of $5.00 per range of this quota for local advertising.
6. Carry on a local advertising campaign in co-operation with dealers, either through the newspapers, by hand bills, bill boards or in some way to keep customers informed that a campaign is under way.
7. Display electric ranges in the local office if possible or arrange for an outstanding display in dealers' windows and stores, especially during the real range season—April 15 to July 15.

FREE 3-WIRE SERVICES.

During the past few years the sale of electric ranges and other major appliances has been retarded through the fact that purchasers of these appliances required a new 3-wire service of ample capacity to handle them, and the cost of installing these services and wiring has been beyond the pocket-book of prospective users.

At the January Convention of the A.M.E.U., during the discussion of a paper on the present trend in domestic service entrances, the following resolution was adopted:

"That this Association places itself on record as favoring the use of suitable cable for domestic service entrances, and in view of the saving that will result from the use of such cable it is recommended that the municipalities absorb the cost of the same (service entrances) as part of the distribution capital."

This resolution, accompanied by data on the cost of 3-wire services and the economics of installing these as

part of a local distributing system, was presented to the Hydro-Electric Power Commission for consideration and endorsation, and as a result formal approval was given for Hydro municipalities:

1. To install a new 3-wire service for domestic consumers, where necessary, up to and including the service entrance switch at no cost to the consumer.
2. If deemed advisable, to make the necessary connections between the new service entrance and existing wiring distribution centre at no cost to the consumer.
3. Where advisable, to make the connections between the service entrance switch or distribution panel and the electric range at no cost to the consumer.
4. To charge the cost of all the above expenditures to a suitable capital account.

Every municipality has been furnished with information on how new 3-wire services can be installed cheaply with the use of the newest materials required for this purpose, and all are urged to adopt the policy recommended by the A. M. E. U. and approved by the Commission. Already a large number of municipalities have fallen in with this recommendation and are installing services free wherever necessary.

RANGE CAMPAIGN IN RURAL DISTRICTS.

The Hydro-Electric Power Commission is extending the scope of the Range Campaign into Hydro Rural Districts and into municipalities operated by the Commission direct. Included in this activity are:

(a) Municipal systems owned and operated by the Commission.
(b) Hamlet and suburban customers in rural power districts operated by the Commission.
(c) Farm customers in rural power districts operated by the Commission.

* * * *

POLICY APPROVED BY COMMISSION
(Commencing April 1st, 1936).

RE FINANCING RANGE SALES AND WIRING.

In municipalities where the local system is owned and operated by the H.E.P.C. and in the hamlet and suburban areas of rural power districts operated by the H.E.P.C., the Commission has approved of the financing of the purchase of a new electric range of 60 amperes or over capacity, whether the range be sold by a dealer, by the H.E.P.C. or by a Hydro Shop, also the installation of a new 3-wire service, if one is necessary, and wiring to the range and connecting to existing wiring.

Before a contract can be made with a customer for financing, approval to his credit must first be obtained through the medium of an application form (Form No. 363 L) provided for the purpose.

RE TERM OF YEARS AND FINANCING CHARGE.

The term through which range purchases and wiring are financed is limited to three years.

A charge of 4 per cent. per year of the financing term will be added to the unpaid balance which remains to be financed after down payments and trade-in allowances, as well as

load building allowances, have been made.

Re Special Load Building Allowance.

The Commission has authorized making a special load building allowance of $20.00 to apply on the purchase of a new electric range of 60 amperes or over capacity at 110 volts, whether this new range replaces an electric range or some other form of cooking appliance.

In cases where the Commission finances the purchase of an electric range, to which the allowance applies, the $20.00 will be deducted from the face of the contract which is signed with the customer and will thus automatically affect the periodical installments which the customer pays under the contract.

In cases where a customer purchases an electric range for cash, or from a dealer on the latter's own financing terms, the allowance will be made in the form of a rebate at the rate of $1.00 per month, to be deducted from the customer's periodical bills for electric service, and application will have to be made for the allowance in cases of this kind on Form 363 M provided for this purpose. The terms and conditions under which rebate will be made are enumerated on the back of this Form.

Re Down Payments.

Where financing is to be done by the Commission a down payment of not less than 10 per cent. of the retail price of the range and wiring must be made in addition to any trade-in allowance made by dealers or the load building allowance given by the Commission.

Re Farm Customers.

Electric ranges have been placed on the list of appliances which can be financed under the Rural Power District Loans Act, and as this Act applies to farm customers only who are owners of the farms they occupy, any ranges which these customers purchase may be financed on the Rural Loan plan if their applications for loan are approved by the Commission in the regular way.

The allowance of $20.00 will apply to purchases of electric ranges financed under The Rural Loans Act.

If a farm customer has a rural loan on which installments are still being paid the commission has ruled that until this loan is fully discharged no applications for loan for ranges or financing privileges will be approved.

The financing privileges outlined in the preceding paragraphs will be extended to farmers who do not come under the scope of the Rural Power District Loans Act, also to farmers who are eligible for a rural loan but do not wish to take advantage of its privileges, all subject to credit approval.

H.E.P.C. Contributions to Campaign.

To encourage Hydro municipalities and dealers to take part in this range campaign the Commission is making some very tangible contributions to the effort, such as:

(a) Providing advertising material for newspaper advertising and window displays and pamphlets for general distribution.

(b) Providing the services of advertising agents to help plan and place local advertising.

(c) Providing an advertising allowance of $3.00 for each new electric range sold, to help dealers defray part of their advertising costs.
(d) Providing a sales manual for range salesmen.
(e) Providing services of representatives to help organize local campaigns.
(f) Sponsoring a talking picture cooking school to be shown in over 150 theatres in the Province during April, May and June.
(g) Displaying ranges in Hydro rural office whenever possible or in local dealers' windows in towns where rural offices are located.

MANUFACTURERS OF RANGES.

All the manufacturers of electric ranges have laid out an elaborate program of advertising and sales promotion and are enthusiastic about the prospects for this year's Campaign. With the foundations that were laid during the past twelve months and the feeling of co-operation which has been established with the dealers we have every reason to believe that our efforts this year will be amply rewarded.

The Western Ontario Electric Meter Association Meeting

The Western Ontario Electric Meter Association held its first meeting after organization at the William Pitt Hotel, Chatham, on January 17th, 1936. There was a total attendance of sixty; 44 representatives being from 19 municipal electric utilities, 13 from five manufacturers, two from Dominion Gas and Electric Inspection, and one from the Hydro-Electric Power Commission of Ontario.

There were two papers presented and discussed. The first paper "Diversion of Electric Energy," by F. D. Hubbell, Windsor Hydro-Electric System, dealt with the various methods employed where consumers had attempted to obtain current by tampering with the meters or service connections, and the procedure followed in detecting and overcoming such diversion.

The second paper "Proper Meter Maintenance" was presented by J. C. Smith, Dominion Gas and Electric Inspector, London. The paper urged that meters be properly cleaned, adjusted and maintained since by poor maintenace the utility was liable to lose revenue more than sufficient to pay the cost of proper maintenance.

The Western Ontario Electric Meter Association was formed at a meeting held at Chatham on December 5, 1935, and has for its object, providing opportunities for the metermen of the electric utilities in Western Ontario to meet and discuss problems arising out of their work. The President is R. S. Reynolds and the Secretary, Ivan N. Pritchard, both of Chatham Public Utilities Commission.

Symposium of Lighting Promotional Activities

(Addresses to Association of Municipal Electrical Utilities at Toronto, January 29, 1936)

By G. J. Mickler, H.E.P.C. of Ontario

AS you all know, at the Convention in January of last year an invitation was extended to the A.M.E.U. by the Commission to appoint a committee to co-operate with its representatives in planning such load building activities as both the Commission and the municipalities might find necessary.

As a result, a General Committee on Load Building was formed; the A.M.E.U. appointed the executive as its representatives and the Hydro-Electric Power Commission appointed Engineers of the Municipal Department to represent it on this committee and the work of organizing load building activities began.

At the first meeting of the General Committee a number of Sub-Committees were appointed, one to handle each major division of load building and one of these committees was the Lighting Committee.

The duties of this committee were outlined as follows:

To develop plans for Campaigns on Home Lighting, Store and Office Lighting, Industrial Lighting, Street and Highway Lighting.

After holding several meetings the Lighting Committee made several recommendations and passed them on to the Main Committee for approval and final transmission to the Commission for action.

The following are some of the more important of these recommendations:

1. That the Hydro-Electric Power Commission inaugurate a Provincial Lighting Campaign as soon as possible to cover all phases of the lighting field, Domestic, Commercial, Industrial, Street and Highway Lighting.
2. That a Lighting Director be appointed who should be provided with a staff to direct the lighting activities of the Commission and assist municipalities to launch and conduct local campaigns.
3. That the Hydro-Electric Power Commission sponsor the conducting of a lighting school in Toronto the week of March 11th, 1935.
4. That all municipal engineers be asked to attend this school to equip them to sell the Better Light idea to Hydro muncipalities.
5. That an invitation be sent to all Hydro municipalities to send one or more students to attend this school.
6. That following this school the Commission provide facilities to continue instructing students in the Science of Seeing.

These recommendations were embodied in a report made to the Commission and led to the Commission setting aside an appropriation to provide funds to carry out the recommendations of the committee.

One of the first things which the Commission did was to sponsor the lighting school which was conducted in March, 1935, under the auspices of

the Canadian General Electric Company by their Nela Park experts.

Invitations were sent out to all Hydro municipalities, to dealers and others interested in Better Lighting, and in all, over 450 attended the four day sessions. All the Hydro municipal engineers attended, as well.

A great deal of interest in lighting was stirred up as a result of this school and quite a number of municipalities who had representatives in attendance were anxious to start something immediately to put into practice the theories which had been demonstrated at the school. However, as the lighting season was almost over, it was deemed unwise to start a Provincial Lighting Campaign until the late summer or autumn. Furthermore, plans were being developed to embark on a range campaign in April, and it was impossible to conduct these two campaigns simultaneously.

Early in August, the Lighting Committee met again to discuss plans for an active campaign as soon as the lighting season should open, and it was decided that as soon as the Toronto Exhibition was over lighting activities should commence, and tentative plans were laid to take care of the details of the Lighting Campaign.

It was recommended that a definite plan be developed, similar to the Range Campaign plan, and that a plan book or manual, similar to the Range Campaign manual, be prepared for the use of those actively engaged in the work of planning and operating a lighting campaign.

It was recommended also that a training course be given to representatives of Hydro municipalities who will be directly charged with the sale of lighting. It was felt that the lighting school held in March did not thoroughly equip one to go out and do a good selling job of modern lighting equipment. Furthermore, those who attended the school in March were largely Hydro Managers and not those who would be going from door to door as home lighting experts.

It was also recommended that the Commission engage experts to help in local organization work, also, that advertising material be provided for the use of the municipalities.

At the Canadian National Exhibition, in the Hydro Exhibit, we had a display, or rather a demonstration, of proper home lighting, having equipped a large space as a model living-room and furnished it with the latest home lighting equipment. A great deal of interest was displayed in this exhibit. We received a lot of inquiries, not only from Hydro consumers in Toronto and the neighbouring municipalities, but from all over Ontario, and we were sufficiently impressed to encourage us in proceeding with our Lighting Campaign plans.

Representatives of many Hydro municipalities were anxious to get a local campaign started as soon as possible.

Immediately after the Exhibition, we planned to hold a lighting school. A four day training course was mapped out, lectures and demonstrations were prepared from the very best material available, and the best talent we could get secured as instructors and demonstrators and the courses in lighting provided by the LaSalle Extension University were subscribed for and made available to the lecturers and demonstrators and

formed the basis of the instructions given. During the week of November 12th, from the 12th to the 15th, we conducted a four day school. This was attended by upwards of forty students, representing twenty municipalities, several department stores and dealers.

These students received instructions on the elements of the Science of Seeing; they viewed demonstrations of how lighting should be sold in the home; they received instructions on the latest developments in home lighting equipment and how it should be sold, and as we had on display over one hundred units of the latest types of I.E.S. and other floor and table lamps, produced in Canada, they were made familiar with the different types of equipment which are on the market. They were acquainted also with the cost of these lamps, where they could be obtained and what they would do.

On the whole, this first attempt at a lighting school seemed successful. Those who attended were impressed with the knowledge they had received and with the possibilities of success in applying their knowledge, and we hoped that when they returned home they would commence some lighting activity in their respective municipalities.

Outside of three or four cases, however, very little real campaigning was commenced. There seemed to be a gap in the organization, that of lack of information among the dealers who sold lighting equipment, and we accordingly planned to fill up this gap. We employed three ladies as Home Lighting Experts, girls who were trained in the selling of lighting, in demonstrating and teaching lighting principles, and we sent them out into the field to interview the dealers and to discover how they were equipped to co-operate in a lighting campaign. It was found that in general the dealers had very little knowledge of the new Science of Seeing story. Very very few of them had any of the modern lighting equipment for sale and those who did treated it as ordinary merchandise, not as something new and scientific. The dealers interviewed expressed a desire to learn something about seeing and welcomed the suggestions that we teach them as much as possible on this new idea. Accordingly, we mapped out a course of instructions for dealers.

Realizing that dealers could not afford to be away from business for more than one day, we planned to give as much information in a one day course as possible, and we found finally that even one day was too long, so that the instructions had to be condensed into a good half day's program, and we endeavoured to put into this program as much material as is necessary to enable a dealer to talk intelligently on the Science of Seeing when selling new types of lighting equipment.

Up to the time of this Convention a Dealer Lighting School was held in Sarnia, at which nine dealers were present; another was held in Kitchener, which twenty-six dealers attended, and one in St. Thomas where twenty dealers were present.

Reports of these schools are sufficiently encouraging to warrant our planning to hold more such schools immediately. Our plans in connection with these will be announced later.

Following the Training School in November, and after engaging our Home Lighting Experts, we planned to have these experts gain some direct experience in the field in order that their work in the municipalities would be easier and that the municipalities would know that they have had practical field experience. We accordingly arranged for meetings with local clubs to get experience in addressing the public. We arranged for a large number of home calls and demonstrations, and considerable time was taken up attending to these, and arrangements were made also to place our experts on the floors of the largest department stores to gain experience in the selling of I.E.S. and other lighting equipment.

In travelling about from town to town to help in local campaign work we want the municipalities to feel that our experts have a knowledge and experience which fits them for the work, and with your co-operation they would be of real help to all municipalities in the Province when a general lighting campaign commences.

As a stimulus to the Better Light—Better Sight movement, we arranged to have our staff acquainted with the principles and prepared a short program of instructions for groups of fifty or more, and carried on meetings until all those of the staff who desired to attend these meetings had an opportunity of doing so. Out of these developed a large number of home calls and Hydro employees are most enthusiastic now in advertising the Better Light—Better Sight idea.

At the time we mapped out our course of training in November, we found that there was no Canadian literature available for distribution among Hydro consumers embodying the principles of Better Light for the Home, so we set about to produce a Booklet—"Let's See," a sample of which was sent to each Hydro municipality with the request that they buy a sufficient quantity of these booklets to give one to each domestic user, because we felt that if one of these should find its way into the homes of Hydro consumers in Ontario you will be breaking down sales resistance to Better Lighting when the campaign starts and pave the way for its success.

May I say in passing, however, that up to the present time we have had rather poor response for orders for this booklet. In producing it we tried to put into it the very best material available, and we tried to keep the cost as low as possible. In order to accomplish both purposes we must dispose of a substantial quantity, so if you have delayed unnecessarily giving consideration to the purchase of this booklet. I would appreciate your giving it your immediate consideration.

As recommended by the committee, we are preparing a Plan Book or Manual for the guidance of those who will take an active part in lighting campaign work. In order to facilitate organizing a lighting campaign it is necessary that a definite plan of action be available, and in order to have a Provincial Lighting Campaign as uniform as possible it is found necessary to suggest to all Hydro municipalities and others ways by which a uniform campaign can be carried on. Up to date we have produced a Plan Book in its preliminary stages, and it is pro-

posed to pass this a sample around among the various branches of the industry for criticism, and when finally revised to have it printed or mimeographed and distributed among all those who should have copies.

In this Plan Book, which is divided into four parts, there is a short presentation of the Science of Seeing story for the benefit of Hydro municipal officials, and there is a copy of the "Let's See" booklet for public use. In the second part, we point out the advantages of a lighting campaign to each branch of the industry and then proceed to tell each branch how it should co-operate with the other branches for the most satisfactory results. The third part of the manual outlines a method of planning a local campaign, describing the steps to be taken by the local Hydro officials and other local organizations. The fourth part of the Plan Book consists of a suggested Advertising Campaign Plan for local newspaper advertising purposes.

Our plans for the immediate future are:

First: To carry on with the Dealers' Schools in as many municipalities or centres as it is found possible to get together enough dealers to make a school worth while. Already plans have been laid to conduct a school in Chatham, Stratford, Brantford, Woodstock, Welland, St. Catharines, Niagara Falls, Hamilton, Toronto, Oshawa, Belleville, Brockville, Kingston, Smiths Falls, Peterboro, Owen Sound and Barrie, and by the end of March this ground will all have been covered.

In connection with the holding of these schools, if anyone present has an idea that a school would be well attended in your municipality, we would be glad to co-operate with you in putting on such a school. It takes from 1½ to 2 days per school, one day of preparation and one day to carry on the lectures and demonstrations, and it is always possible to arrange to have one or more of the lecturers or demonstrators give lectures on the side to Women's Clubs, Service Clubs and the like during one or the other or both of the days of the school period.

Second: We intend to organize additional Schools of Instruction for Home Lighting Experts and will hold another school just as soon as the demands of the municipalities warrant it. We require about 40 students at least to make such a school a success. The cost of running a school is about $1,000 and we would like to have as many municipalities as possible send students so the money will be well spent.

While on the subject of instructing Home Lighting Experts, may I exhort you, if sending students to a school, that you send those whom you expect to have in the field later actively selling lighting. Please do not send someone whom you know will not be going from door to door expounding the principles of Better Light—Better Sight. It is impractical for a Local Manager to come to the School and expect to pass the information he receives on to a subordinate and expect the latter to conduct a successful lighting campaign at a later date; it is hard enough to get the information for your own use without passing it on to someone else, and since instructions are given in the school by means of equipment which is not available

locally it is impossible for one to get the information properly without attending the central school or receiving instructions in a similar manner.

Third: It is our intention to have our Home Lighting Supervisors visit the various Hydro municipalities from which dealers and other representatives attended Dealers' Schools. Their duty will be to visit these dealers and help them interpret the instructions they received on a previous occasion, also to help them in their home calls, and, incidentally, to assist the local municipal officials plan and organize a local lighting campaign.

Fourth: As stated above, as soon as our Plan Book has been revised we intend to distribute copies wherever necessary, and these Plan Books should be studied by all who would like to put on a lighting campaign.

Fifth: We will supply advertising material as outlined in the advertising section of the Plan Book to municipalities or dealers for local newspaper advertising. That is, we will supply the mats or cuts which may be required.

Sixth: We will help local municipalities plan their advertising campaign and give the services of our advertising agents, if necessary, to help place the actual advertising in the newspapers.

Seventh: We will help the municipalities in every way possible to put the lighting campaign across.

When we organized our range campaign a year ago there were some who stated that a range campaign can hardly be expected to be as successful as some other form of activity, because, first of all, there were a large number of ranges in service, and, secondly, because of the large number of people out of work Hydro customers could not afford to buy ranges and install the wiring necessary to operate them at this time. With a lighting campaign, however, they said it would be different. Here is something with a tremendous appeal and something which rich and poor alike could take advantage of to a greater or a lesser degree at little initial outlay and if we would plan a lighting campaign many municipalities would fall into line to make the campaign a success. The surprising thing, however, is that since we have shown an active interest in this kind of planning it is difficult to get some of those whose opinions are expressed above to take any action. They are willing to do something, but not to do it in a big way.

This lighting business is a big job. Lighting cannot be sold like vacuum cleaners, brushes or toilet preparations; it must be sold scientifically, and in order to sell it properly you must have some scientific knowledge. This cannot be obtained without going after it. It means that in every municipality where a real lighting job is to be done some real individual effort must be put into the campaign. It cannot be said "We will have a campaign," and then let the campaign run itself. It just cannot be done, and, furthermore, in order to put a campaign over properly every branch of the industry, local and provincial, must co-operate to the fullest possible extent.

Now, I myself, have spent some time among the manufacturers of lighting equipment to discover what

are their plans for distribution and I must say that I was disappointed in what I learned. Some of the manufacturers do not know how their lamps are being sold. They sell to jobbers and forget about them. Some manufacturers have their own dealers but most of these dealers are not equipped with modern lamps and know nothing about their use and sale, and so far as I could learn they are making very little preparation to educate their dealers as they should be educated.

If a lighting campaign is to be successful local dealers must be equipped with lamps and fixtures which will provide the quality and quantity of illumination desired and the dealers who are selling this equipment must know something about lighting to be able to sell this equipment properly. We hope when our Dealers' Schools have run their course and the field work we are doing among the dealers has been well under way that we will have laid the foundation for a reasonably successful lighting campaign.

The present lighting season is about to close and we cannot hope to show very tangible results from a so-called lighting campaign this lighting season, but I feel that if we carry on with our spade work among the dealers, among the municipalities and the Hydro consumers we will have prepared the way for a real activity in August and September of this year, and to those municipalities where it is felt that a lighting campaign would be of real benefit to them and to their consumers we will be ready and willing to co-operate in planning and organizing local efforts.

* * * *

By W. H. Childs, Hamilton Hydro-Electric System

I think it is very interesting to get a report from the various municipalities as to what has been done in connection with the Range Campaign and the Lighting Campaign.

From our own experience, I may say that the Lighting Campaign has gone over in a tremendous way, much better than I had ever had any hopes of it doing. It is quite true, we haven't done all of the things we should have done and we have left undone a few of the things we should have done. However, there has been a lot of lamps sold in Hamilton and I am personally convinced that it is one of the finest methods of load building that we can possibly indulge in. After all, I suppose ninety-five per cent. of the use of this additional lighting, in the homes particularly, will be in the off peak period, after six o'clock at night, and as some of the engineers of the Hydro can attest, if we can just get a few more lamps on at night we won't have any off peak current. I think it is very, very important, that something could be done with the dealers. Our experience has been that they are rather a difficult class to deal with. In the first place, they have a very large stock of lamps that are not suitable for a campaign such as we are putting on and they naturally have a great desire to get rid of them. Many of the dealers took advantage of the campaign before Christmas to advertise their other lamps and push these other lamps on the poor, unsuspecting public, and the public fell for them to quite some large extent. I do feel though, that the campaign should be

carried on. I think it requires constant advertising and constant pressure.

Mr. Mickler spoke of the inactivity of some municipalities and particularly in connection with the Range Campaign, that they said, there is no interest in ranges, but wait until the lighting campaign starts.

I rather think we are all pretty well in the same box, in that regard. We have been sitting down, calmly, for the last five years, practically sound asleep, letting the gas companies go ahead with an energetic campaign and they have completely swept us off our feet and to be quite polite, we are all just stalling.

It is a serious position to be in and if we are going to do anything about ranges and get ourselves back in the standing we were in a few years ago, it is going to take a lot of effort and it isn't going to be done in one year, not by any means.

It will be with ranges, similarly with the lighting campaign, constant effort and constant pressure will be required and while we, with the rest, have been sound asleep, there is no question that we have had very energetic competition from the gas companies, and at the same time, generally speaking the municipalities have not taken advantage of the opportunities that have been presented to them, and I, personally, feel that this should be done, both in the Range Campaign and in the Lighting Campaign.

* * * *

By B. W. Grover, Public Utilities Commission, London, Ont.

With a great deal of pleasure we are able to announce that the Better Light—Better Sight Campaign has been successful in all its phases so far as London is concerned. The campaign was undertaken with considerable trepidation, not due to any doubt as to the value of the Better Light—Better Sight movement but having in mind the ultra conservative attitude of London citizens towards any innovation. We have found the average citizen, whether he be an executive, factory superintendent or householder, unusually interested in our story and willing to give a considerable time towards further enlightenment. The few exceptions encountered only prove the rule. In fact, in several cases, we found that those most emphatic in their objections at the time of our visit have since adopted many of our recommendations surreptitiously. Evidently their business policy did not allow them to believe that anyone could have disinterested motives.

The quota we set ourselves in August, 1935, for the year was 200 kw. About 30 kw. had already been obtained on a preliminary canvass and it was considered that with adequate promotional work this quota could be obtained. With an average revenue of $30 per kw. per year we felt justified in spending a year's revenue, or a total of $6,000 to obtain the 200 kw. load.

The entire month of September was given over to publicity purposes. In the introduction of a new idea such as this, publicity in all its phases was of utmost importance to acquaint everyone with our aims. A booth was equipped at the Western Fair and an exhibition given in a vacant downtown store in which the wholesale distributors and manufacturers cooperated splendidly. Suitable news-

paper advertising was arranged in conjunction with these exhibitions and consisted of two double-page spreads in which all allied interests co-operated with smaller one and two column displays. This newspaper advertising was continued with a double page co-operative spread once a month supplemented with smaller follow-up ads. The publicity was directed toward the home lighting field primarily as we considered that this would indirectly open up our other fields.

Commencing on October 1st, we started out to reap the benefits of our advertising. The results are divided into their two main classes (1) domestic and (2) industrial and commercial. Two hundred and twenty kw. was obtained or 10 per cent. more than the quota set in August. Final figures of cost are not yet available but they approximate $5,500 or some 8 per cent. less than our August estimates. These figures justify our previous statement that the cost of adding lighting load is about equal to the annual revenue derived therefrom. This is somewhat higher than the General Electric figure but it must be remembered that the revenue per kw. is higher in the States, and the attitude of the United States public is less conservative.

Domestic Campaign

The home lighting staff consists of three girls one of whom also looked after office records and correspondence. These were trained at a special school organized early in September. Two had also attended the Hydro-Electric Power Commission school in March. All were equipped with the General Electric home lighting kit and report that they found it a tremendous help in making sales. In three months they made 271 calls and 191 return calls. It might be interesting to hear the sources of these prospects:

Obtained from satisfied customers	65
Direct mail advertising	48
Exhibition in vacant store	45
Contacted in Hydro Shop display	44
Exhibit at Western Fair	33
Calls resulting from news ads	6
Obtained from dealers	2
Turned over from Home Service Dept.	1
Miscellaneous	27
Total	271

It appears from this that satisfied customers are our best source of prospects, followed closely by direct mail advertising. To obtain these direct mail prospects we sent out 250 letters and followed them up with 'phone calls. The Hydro Shop display is a small model room lighted to Better Light—Better Sight standards. One of the girls is on duty here every afternoon.

The combined results of the activities of these girls was an additional load of 42.515 kw. This figure is what was actually found installed on return calls and as the return calls made at December 31st are only 70 per cent. of the recommendations it follows that this figure is only a partial indication of their efforts Total wattage recommended was 61.0 kw. or, in other words, 69.6 per cent. of the recommendations made have been installed and verified. Watts per call averaged 157.

At the same time consumers had been buying better light lamps at the various electrical and department stores as the result of our publicity efforts. At December 31st approximately 370 lamps had been sold of which 285 were trilites. Deducting those included in the lighting advisors installations and making due allowance for out of town sales, this is still equal to some 45 kw. additional load. It is interesting to compare this with sales for the 18 months prior to the opening of the campaign in September. The combined sales for the entire city over this period was about 30 and most of these were study lamps sold by the Hydro Shop. To sum up, approximately 90 kw. have been added to the domestic lighting load due to our activities over a four month period. These figures make no allowance for the increases made by consumers unaided after attending our exhibitions and reading our newspaper articles.

Commercial and Industrial Campaign

Some difficulty was encountered finding someone who was trained both as a salesman and a lighting advisor. We finally compromised with one of each and found that the combination worked splendidly. The salesman made the contacts and did the necessary ground work and then called in the lighting advisor who made the recommendations. The salesman was then responsible for closing the sale. This conserved the time of the lighting advisor who also made estimates for the wiring department. Incidentally this placed him in an excellent position to discuss re-wiring costs with the lighting customer. At the same time the salesman was receiving a first-hand training and is now capable of making all the less important recommendations himself. Where more voluminous reports were required, they were prepared with collaboration of both the salesman and the lighting advisor. However, it was found that trial installations were a more effective way of making sales and consequently these were made at every available opportunity. The biggest obstacle encountered was the fact the increased wattage meant, in the majority of cases, new fixtures and re-wiring and in several industrial installations larger transformers. This, coupled with the fact that the end of the year was rapidly approaching, resulted in many of our recommendations being laid over until the new year. However, we expect to close most of these now. One hundred and twenty-one contacts were made and 95 recommendations submitted. Eighty-one of these were adopted either wholly or partially, resulting in a total increased load of 130.670 kw. It is interesting to note the various fields in which these were added.

The largest installation made was 10.1 kw. in a box factory and the smallest 180 watts in an office while the average installation was between 1 and 2 kw. These figures indicate that practically none of these consumers have made a complete installation and constitute, therefore, a profitable source of future business. The total wattage recommended was approximately 200 kw. At this assumed figure the installed wattage is 65 per cent. of the recommendations. In our consideration these results are ex-

Commercial and Industrial Lighting Installations Adopted

Industrial	31.980 kw. with	9 installations
Industrial (commercial rates)	12.130 " "	10 "
Banks	10.350 " "	6 "
Stores	28.330 " "	26 "
Offices	24.450 " "	16 "
Signs and Displays	8.600 " "	.. "
Halls, Churches, etc.	14.830 " "	14 "
	130.670 " "	81 "

tremely gratifying as 90 per cent. of these recommendations were made after October 1st, and we believe most lighting sales people expect a lapse of from 3 to 6 months between recommendation and installation. It indicates an extremely favourable condition for our activities in 1936.

We started this campaign with none of our citizens knowing the least thing about it. In a four month period, for an expenditure of about $5,500, we have acquainted everyone with the ideals and principles of this important new science. At the same time we have added 90 kw. domestic and 130 kw. commercial to our load which more than justifies the expenses involved. Some fifteen engagements have already been made to address various home and school clubs and business organizations.

Everyone is showing an active interest in our activities and we look forward to obtaining our 1936 quota of 400 kw. with considerable less perturbation than we felt last August. Better Light for Better Sight has become an established institution so far as London is concerned.

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By F. S. Rhoads, Windsor Hydro-Electric System

We have been asked by the Papers Committee to give a symposium of the results to date in the Better Light—Better Sight Campaign in Windsor. As yet, no definite figures are available, but I will try in a very general way, to outline the extent of our activities, and the probable trend of our future program

In November, 1934, the Windsor Hydro saw fit to inaugurate a Better Light—Better Sight program. Of a necessity, the local policy of "Dealer Co-operation" rather than "Shop Sales", required certain modifications in the Campaign, to what would be encountered in the old style Hydro Shop. Primarily, our program has been one of "Employee Education" with the end in mind of forming a strong nucleus of workers who, armed with the knowledge of Better Light—Better Sight, would be in a position to impart information to the consumer, when the opportunity presented itself. Our advertising has been modified in the educational direction, as opposed to specific appliance promotion. In line with our "Dealer Co-operation" program, the next step has been to disseminate Better Light information

to the electrical merchandisers throughout the city. The response has been, I might add, most gratifying.

Through the kindness of the Michigan Section of the Illuminating Engineering Society, we were able to bring members of our staff and a number of interested and influential merchandisers to a greater understanding, and enthusiasm, for the Better Light—Better Sight program, by attending the monthly meetings in Detroit. This work was supplemented by a series of four lectures in the Prince Edward Hotel in Windsor, to which were invited representative numbers of the classes to whom lighting has an appeal. Our audiences consisted of electrical dealers, departmental store employees, optometrists, members of School Boards, and Teaching Staffs, and members of Home and School Clubs. The interest and response has been very gratifying, and it is not inconceivable to predict a condition of light consciousness among these people, which will pave the way for a profitable return for the efforts expended.

The Windsor "Fieldman Plan" has been the method of carrying the story of lighting right into the consumers homes. Some very good results have been obtained. At all times we have endeavoured to convey the impression that we were primarily interested in showing the consumer how to improve lighting conditions without expense, and we have found that in this manner, our fieldmen have been extremely successful.

This very general groundwork has been supplemented with a "Model Living Room Lighting Exhibit" in our downtown office, by means of which we were able to show consumers just what good lighting really means. A large portion of people paying their bills in the office, were thus able to be reached, and another link was forged in the chain of Better Light knowledge. Along the same lines, the remodelling of our downtown office gave us the opportunity to modernize the lighting; indirect units were used, and a 50 foot-candle intensity obtained. We feel that this installation will have a special appeal to commercial consumers.

The results we have obtained from our lighting promotional activities are, up to now, more or less, indefinite, but if you will permit, I will give you some idea of what we have accomplished in lamp sales. In 1933, we sold approximately 13,452 light bulbs for home lighting. In 1934, we sold 15,360. For the first eleven months of 1934, we sold about 400 one-hundred watt lamps, and after getter the Better Light—Better Sight program under way, we sold one-quarter of this amount in the month of December alone. Since that time, 60 watt lamp sales have increased more than 100 per cent., and sales of 100 watt lamps, a similar amount. For the year 1935, our total lamp sales for domestic use was 22,583. This represents a sizable increase in load, and in itself, is justification I believe, for our participation in Better Light—Better Sight Campaign.

This, I think, covers our promotional activities, in the Better Light—Better Sight Campaign in 1935. Early this year, we conducted a series of conferences with local electrical and furniture dealers, and formulated our

Lamp Sales Campaign. Twenty-two special salesmen were hired, and put through a week's intensive training under the direction of our staff, who had already been instructed over a period of more than one year. An intensive advertising campaign was commenced in co-operation with the interested dealers, and we feel that we secured an adequate coverage of the city in this manner. Our campaign procedure is to endeavour to place the lamp in the home for demonstration, over a two-day period, and then the sale is usually closed. These lamps are sold and the sale contracts are carried by the participating dealers. The Windsor Hydro is carrying the load of promotional work, and turning the sales over to dealers. Thus we are living up, in the fullest sense, to our plan of "Dealer Co-operation."

I might say that we find ample justification for this policy, in that we are now able to foster an ever-increasing tendency on the part of merchandisers to emphasize electrical sales, and this is, as you all know, a very desirable state of affairs.

Now, gentlemen, you will agree with me that the Better Light—Better Sight Campaign is definitely under way in Windsor, and I think you will further agree that we have approached the problem in a way that will not contradict our local Load Building policy. Our aim and hope which bids fair to be realized is to weld those organizations which have a common purpose—the furthering of the cause of electricity—into an organization which will exemplify the ancient adage —"In Unity there is Strength."

* * * *

By G. W. Austen, Electric Service League, Toronto

I am not in the position of being able to make any general statement on behalf of the lighting operations carried on in Toronto as a whole. As you all know, the Toronto Hydro system has a lighting service department, it has men of its own out in the field all the time and their report, I suppose, would be especially good, if presented.

What I do want to do, though, is to outline what the Electric Service League is doing in the commercial and industrial lighting field, because the system we have inaugurated in handling this work, I think, will be of very great interest to the lighting industry as a whole.

Staring last April, more by accident than anything else, we began our office lighting work. The results in jobs we had to handle and in increasing lighting efficiency were so good that it quite surprised us, and we began this system we have been building up, with results that promise to be rather remarkable.

After our lighting experience with the offices, we put a man on factories, of which there are about two thousand and the results came through splendidly. It seemed to require almost an immediate enlargement of field man power and I asked the co-operation of the Toronto Hydro system in the matter, and obtained it in ten minutes, and we now have four field men operating on commercial and industrial lighting.

The rate structure in Toronto is such that commercial and industrial lighting is particularly favoured by the central station and so far the work

of the League has been confined pretty much to that particular field.

I have a little black book here in which we have recorded the jobs that we have handled on behalf of the League, alone. There are about ten pages of entries. Some of them are quite big jobs of increased lighting, applying to stores, offices and factories. The minimum increase we have a record of in any one job is fifty watts. The maximum is ten thousand watts. A lot of them, are two, three, four or five thousand watt advances. The total wattage increase we have been able to record for 62 jobs, out of those entered on the book, is 160,000 some odd hundred watts. Of the total 146 jobs on the books, at the end of the year, it is very easy to figure a minimum of 200,000 watts.

Our system of working is quite simple. Owing to the fact we are a co-operative organization, representing not only the central station but also manufacturers, jobbers and contractors, there are some angles in this promotion system of ours that are rather difficult at times, but the operation primarily, is intended to build load for the central station. The other benefits to equipment sales, and lamp sales come in incidentally.

The operation, so far as factories are concerned, consists in canvassing, the making of a survey of a factory, the entering of the foot candle readings for the various departments, then on a form we have for the purpose the entering up of the intensities, as they ought to be. Those reports are sent through to the heads of the factories.

In probably two or three dozen cases we have been able, by this system of sending reports from these surveys to the heads of a factory, to sell them on the idea that their lighting is entirely inadequate, when as a matter of fact, we know that the same managers of that factory turned down the lighting salesmen who had gone in to sell equipment.

The need in selling industrial lighting in particular is to demonstrate, not to the superintendent or even to the maintenance man, but to the head of the factory, that his lighting is woefully inadequate. This little system we have of making the survey and sending through a report of the lighting that a factory has and the lighting it ought to have, gets attention very quickly, and usually results in some very definite action being taken quite quickly.

I could tell of the case of a very large factory in Toronto—quite a big job is going through at present—where the Manager told us that he had turned down half a dozen lighting equipment and lamp sales men who had been in there to see him, because he thought they were merely selling equipment. He didn't know anything about his lighting and until he saw our reports he was simply going along in the dark and not interested at all.

Now, the 200,000 watts of increase from League work in Toronto is not a very large increase, considering the size of the City, but the important thing is that the system we have developed is going to lead to a very much bigger operation. Having got this hold on the situation, we are proposing for this year to enlarge it very greatly. About $10,000 is the amount that will be involved by the League in lighting promotion for 1936.

We are going to start in February, issuing a "Better Light—Better Sight" bulletin, of a character that will enable us to carry out this lighting promotion work much more effectively, because one big lack in selling lighting to industry, also to offices and stores, has been the fact that most managers of these places don't know what is going on. A bulletin that will carry the story of what other people are doing will, I think, induce a psychology that will have a very big effect.

I don't know that there is a great deal more to say at present, but I am perfectly certain with the lighting promotion work being carried on the way it is around Ontario, with the sponsorship of the Ontario Hydro and the interest of the whole industry, that in Toronto we can do a very much bigger job than so far has been done.

* * * *

By G. G. Cousins, H.E.P.C. of Ontario

These reports show what is being accomplished in lighting improvement by solicitation. A great deal is being accomplished without solicitation by the Commission's Illumination Laboratory. This work has been going on for more than twenty years and has been steadily increasing in volume. Last fall an increase in the staff was necessary in order to supply the demand for lighting service. There has been an unprecedented request for school lighting plans from many parts of the Province. It is apparent to even the casual observer that the general level of school lighting is woefully low. On dull days the children at desks farthest from the windows try to work under intensities that are the equivalent of candle light in a great many cases.

One of the disconcerting phases of this work is to carefully plan a lighting system and then have a dealer or contractor reduce the number of outlets and the size of lamps and in doing so he provides his clients with a lighting installation that is decidedly below reasonable present day standards, of very little practical value and the cost is out of proportion to the benefits derived.

There is an increasing demand for higher intensities than were accepted a few years ago and this requires careful planning so that glare is not increased in the same proportion as the intensity is.

The educational work that we are carrying on with electrical dealers to impress them with the reason for and the value of good lighting and to instruct them in some of the fundamentals of good lighting should result in substantial benefit to all concerned.

A good lighting installation serves as an object lesson and it very frequently happens that it leads to several others in the surrounding district.

The fact that all of this work comes to the Illumination Laboratory without solicitation is sufficient evidence of a growing appreciation of the value of good lighting.

House Building Means Load Building

By J. F. Quinlan, Manager, G.E. Home Demonstration Dept., General Electric Company, New York.

(*Presented to the Association of Municipal Electrical Utilities at Toronto, January 29, 1936.*)

WHETHER it is our national virtue or our national vice, I do not know, but the country across the border, from which I come, ever has had a fondness for experiment. Some have been successful, others—not so successful. As an example of the latter, I cite our period of prohibition.

But I am here to tell you of one of our successful experiments, General Electric's New American Home Building Program. That it was an experiment, none *will* deny. That it has been a success, none *can* deny.

Some 315 of these General Electric "New American" houses fully electrically equipped, stand to-day as tangible evidence of the success of this experiment. These houses, translated into the measure of your product, represent an additional load on the power lines of the United States of approximately one million kilowatt-hours annually. This is a most conservative figure which does not take into consideration another load which came through the sale of individual appliances induced by the display of these 315 New American houses. Sales followed the period of demonstration, both of houses and of appliances. We have enthusiastic reports from builders, from distributors and dealers to substantiate this statement. I do not believe that it would be unreasonable to state that another million kilowatt-hours have been added to the annual power consumption of the country through appliances sold as a result of the showing of these houses. This addition represents a secondary benefit to the central station industry following General Electric's experiment. Thus we have a total of two million kilowatt-hours added to the power consumption figures of the United States. Of course this increase in ratio to our twenty-three million meters may not be regarded as startling, but as an indication of what an experiment has accomplished, an experiment which covered less than nine months of actual promotion, it carries inferences and promises which *must* be of interest to the central station industry. Another indication that this experiment has been a success is found in the fact that General Electric has decided to continue this effort during 1936.

Before I give you the story of what we have planned for the coming year, I shall give you a brief history of the New American idea. I shall tell you how it was conceived and the manner in which this experiment was worked out.

The question naturally arises "Just what does 'New American' mean?" There have been many misconceptions of this term. Some have tried to confuse it with a new type of architecture, the stripped, ornament-free functional manner of building which

slowly has been gaining acceptance and recognition in the United States. However, the term "New American" represents something much more broad than a new style in building. "New American" came about in this way.

In the fall of 1934, the General Electric Company sponsored a national architectural competition. The aim of this was to bring forth the finest conceptions of what a modern home should *be*. General Electric wished an opinion from the architects of the country, it sought a visualization of the form it should take, and ideas concerning what should go into an ideal dwelling for the modern American family—a house which would offer the utmost in comfort and convenience; a home which would give the maximum emancipation from drudgery and routine labor in upkeep through the magic use of electrical servants.

Nine thousand seven hundred architects and designers entered this competition and from this contest came a new idea in domestic architecture—not a style, but a basically new idea; a house planned for utility and comfort first; a house planned from the inside; a house where the interior arrangement was of paramount importance.

A term was needed to designate this new idea in home planning. Someone suggested "New American." The name stuck. Let me impress upon you that this description has nothing at all to do with externals. "New American" denotes a home wherein leisure has taken the place of labour. "New American" means a home that is efficient, convenient, livable, economical to operate, and up-to-date in every particular; a home completely equipped with all modern labour saving devices such as the electric kitchen, electric laundry equipment, and the health promoting apparatus for air conditioning, adequate wiring and an abundance of outlets.

These homes are typical of a new outlook on life—a new philosophy of living. Because on this continent the greatest strides have been made in the application of electricity to this business of living, the name "New American" seems particularly apt.

From this it will be seen that the term "New American" has to do only with the interior of the house—the part of greatest importance to those who dwell in the home—and should not be confused with any style of external design.

At this point a reasonable question might be "Why was General Electric interested in home building? What were the reasons back of its sponsorship of an architectural competition?" A fundamental business philosophy of General Electric is "to gain—one must give." Of course, the ultimate objective was to sell electrical appliances. That is our business. However, modern domestic appliances and better living conditions are practically synonymous. Propagate a new ideal of living and the sale of appliances and an increased use of electricity must follow.

For several years back, the best minds in the General Electric organization have been thinking independently along the lines of better housing —betterment of living standards.

Owen D. Young, chairman of the board, has long been interested in this subject; so has Gerard Swope, president. C. S. Wilson, vice-president, also gave much thought to raising living standards. About three or four years ago, Carl Snyder, now manager of the General Electric Home Bureau, quite independently, started to put his ideas on paper. Mr. Synder, having been trained as an architect, made many sketches and plans of houses which embodied the idea of electrical living. From all of this thinking came the architectural competition. For a time it was delayed—this due to the unprecedented business conditions which had overwhelmed the country, which had paralyzed the building industry and put a severe check upon the buying power of the masses.

At the end of 1934, however, a certain amount of light broke through and illuminated what heretofore had been a most dismal scene. Looking over the country in general, it was quite evident that the majority of the homes were and are, the reflection of standard of American life which was left behind in the most advanced sections at least a decade ago. With the promise of a resumption of business and cognizant of the fact that the entire United States was ripe for replacement and replenishment, the latter part of 1934-1935 appeared as the psychological moment to launch the architectural competition. The banks of the country were bulging with money; investors were seeking places to put their money to work. There was no question but that building would be the first industry to feel the effect of better times because it had woefully lagged behind during the years of depression.

General Electric felt at this time that it would be a splendid thing in some manner to crystallize the thinking along the lines of better housing and to gather together all the tangible suggestions for home betterment, which could be garnered from the architects of the country. Of course consideration in this was given to the great advance made by electricity in its domestic applications. Accordingly the General Electric architectural competition was announced. The requirements for entrance were few. The specific designations were that the house plans should include a complete General Electric kitchen, air conditioning, laundry equipment, lighting, adequate wiring and other minor electrical items. In a word, it should be a General Electric home. Further stress was placed on the efficient utilization of space; planning which would give consideration to the sequence of use of the various rooms; economy of construction, and the best utilization of time and labour saving electrical equipment. Nine thousand seven hundred architects and designers entered the competition. Two thousand and forty designs were submitted. From the bewildering mass of plans and elevations, fifty-two were selected as the most meritorious. Twenty-one thousand dollars in prizes were awarded following the rules of the competition. Thus General Electric found itself in possession of a remarkable collection of house plans, all embodying the latest, the most modern in thought and architectural ingenuity.

The next problem was "How best

can these plans be utilized to bring to public attention the advances made in home planning and the designs embodied in them?" General Electric could not let this precious material lie hidden in its files, and so, almost through spontaneous generation, the New American Home demonstration plan came into being. It was the only answer to the problem of proper utilization of the valuable material accumulated.

This was about one year ago. The decision made, at once an organization was set up and plans were formulated whereby the New American idea could be given to the public. Many misconceptions crept in of the part which General Electric would play in this program. Some thought that General Electric actually intended to build a number of all-electric homes throughout the country. This of course was not so. The company did not propose to build houses. However, by making plans available and by allowing its distributors and dealers to give substantial discounts on specified electrical equipment, General Electric sought to stimulate the erection of New American houses in all sections of the United States. A quota of one house to every 100,000 of population was set up, flying squadrons were sent into the field, local committees were organized, and the work got under way. At this time, we issued a large brochure which told briefly the history of the New American idea and carried with it a portfolio containing plans of the prize winning houses.

A phrase which heretofore was unfamiliar to the majority of people, but which was readily understandable by those in the building industry, was given currency. It was "Use Sequence." "Use Sequence" next to the designation all-electric, is the key phrase which best characterizes them. "Use Sequence" is the simple term to describe the simple, common sense home arrangement which has for its objective the elimination of useless effort. For many years, industrial plants, where efficiency is of paramount importance, have had "Use Sequence." The careful planning, utilizing the principles of "Use Sequence" was evident to architects and builders after they had studied the New American prize winning houses. This idea also became evident to the editors of architectural magazines, home building magazines, women's magazines, and many others. The New American idea was seized upon by them as news. Consequently this project without prompting on the part of General Electric immediately began to receive a tremendous volume of publicity. Publications such as McCall's magazine, the Ladies' Home Journal, the Delineator, Pictorial Review, Better Homes & Gardens, House Beautiful, and architectural publications such as Pencil Points, the Architectural Forum, the American Architect, the Architectural Record, all came forward with proffers of editorial attention. One magazine, McCall's for example, sponsored one of the winning designs.

By the late spring of 1935, the New American idea had been spread the length and breadth of the United States. General Electric already had an advertising campaign to further the idea well underway. The result of all this work was a large volume

of commitments from private builders, operative builders, real estate organizations and others, expressing their willingness to erect New American demonstration homes.

When June arrived, there was no doubt in the minds of any of us as to the acceptance of the New American idea. Each day's mail brought in news of other New American houses projected. Our next problem was how to exploit these demonstration homes and how best could we utilize their marvelous potentialities, not only for promoting the sales of our products, but for bringing about a rebirth of the domestic building industry in the United States. The midsummer months were spent in working out these plans. We compiled a comprehensive publicity manual giving step by step the necessary points of building up an effective local publicity campaign for each house. It was about this time that our large Saturday Evening Post advertisement appeared, which was the first instance in the history of the company where one advertisement showed the fundamental domestic electrical appliances manufactured by General Electric. In the meantime, the interest by the public in the New American idea grew tremendously. We obtained an enormous amount of local notice because newspapers recognized the value of the New American plan to general business and also recognized the fact that the erection of these houses, after a long period during which the building industry had been wallowing in the doldrums, was legitimate news, and editors treated it as such.

As the time came close for the first house to open, naturally we awaited public reaction with considerable trepidation, for, as I have stated before, the New American idea was an *experiment*. We did know that public interest was aroused but the extent of this was problematical. Our fears ceased immediately after reports came in concerning the crush of people that stormed the first opening which took place in Marblehead, Mass., Sunday, August 11th. Over 20,000 people passed through this attractive little house on the first day that it was open. As each successive house was opened, the story was repeated. In the New York area where 21 houses were ready for inspection October 12th, in Detroit where 12 houses were opened; in Pittsburgh where 7 houses were shown in the area, reports came in of unprecedented crowds. In several instances it was necessary to call on the police to aid in handling the unexpected rush of visitors. In Chicago where 7 homes were opened on a chill October Sunday 27,000 people responded to the invitation. In Buffalo, in New Jersey, in Portland, Oregon, in Los Angeles, in Washington, D.C., in Denver, in Minneapolis, and St. Paul, in Cincinnati, in Syracuse, in Toledo, where over 10,000 passed through the house the opening day, in fact in practically every principal city in the United States, these New American houses were thrown open to overwhelming crowds.

I assure you that the problem of manning these houses was a very serious one. I shall not go into the details at this time concerning the manner in which visitors were passed through and information given out

in response to their questions. Each person visiting one of these houses was presented with a booklet entitled "How to Make Your Home New American." We printed 2,000,000 of these books and using their distribution as a gauge, it is safe to state that over two million people have passed through New American houses in the United States.

The people who came to these houses came with no other urge but their own avid interest in better living conditions. They came to receive new impressions, to gain new ideas, to broaden their preceptions. Of course, back of their visits was the impelling power of a mighty wave of national advertising and publicity. As these crowds of people passed through these New American houses, their old conception of what a home should be underwent a great change. They saw a vision of tomorrow's home. They peeped into the future. They grained startling ideas on the labour and drudgery eliminating possibilities of electrical appliances. They saw these appliances in action against their natural background. They learned of the principle of "Use Sequence." It is obvious and easy to grasp, to anyone who passes through a New American house. They gained new ideas of space utilization. I do not believe that the average person realizes that most of the houses, built according to standards of a decade or more ago, are often less than sixty per cent. efficient in their utilization of space. These New American houses have utilized space up to ninety per cent. of their cubic contents.

People who visited our houses went back to their homes and saw their dwellings with different eyes. They went back to rooms which looked shabby, obsolete, and of another period. Unconsciously perhaps, they contrasted what they had seen with the conditions under which they lived. Their conception of what a home should be underwent a change and with this change came the urge to possess.

The "Better Light—Better Sight" program came in for a great share of valuable publicity, for it was tied in directly, and each New American house presented a visual demonstration of the principles and practice of modern home illumination.

This booklet, "How to Make Your Home New American" which I mentioned a moment ago, contained a coupon. We were amazed at our New York office, at the volume of these coupons which were sent in requesting information on the various General Electric appliances. The volume became so great that we were forced to put on an auxiliary staff to handle the inquiries. Naturally they were sent back directly to the dealer in the territory from which the inquiry came, in order that he could without delay make contact with the prospect. It is impossible for me to give any definite statement concerning the volume of sales which followed these showings. We have letters of appreciation from dealers and distributors who tell us of specific instances. One dealer told us of selling four complete General Electric Kitchens following the showing of the house in his territory. The same dealer reports greater sales of dishwashers in the two weeks follow-

ing the opening than he had in the two years preceding.

Dealers suddenly awoke to the realization that they had in the New American houses a new showroom, displaying the identical products which they had in their stores—these appliances all installed, connected, and the most of them operating. They saw long lines of people passing through and they further realized that no promotional work which they could have done could have attracted such crowds to their own showrooms. Even if they had called upon the most highly publicized figures of the day, even if they had put in startling theatrical attractions, never could they have induced such a volume of people to visit their stores and inspect their wares.

One interesting sidelight is the number of outside manufacturers who became interested in the New American home plan. Many sought to co-operate with us—manufacturers of paints, of floor coverings, of building supplies. Through our local committee we did everything possible to aid in this co-operation although we made no official tie up with any manufacturer. Utilities were quick to see the benefits latent in the New American plan and universally co-operated to the fullest possible extent.

So far I have given you a brief and sketchy picture of the experimental period of the New American housing demonstration plan. By the middle of December, we were confronted by another question "Did the results of our experiment justify a continuation of our program?" To aid in determining this, we sent out a questionnaire and the affirmative answers so overwhelmed the negative there was no question concerning what we should do. Since then we have effected a permanent organization supplanting the temporary one which functioned during the experimental period. This new organization is headed by Mr. Carl Synder, who by training, interest and experience, is pre-eminently qualified to carry on the work of the General Electric Home Bureau, the name now given to the permanent organization which has the future of the New American house building in its hands. Now I shall give you an outline of what we intend to do during the coming year.

The general purpose of the Home Bureau is to promote more general use of our appliances in the American Home, both those which are to be built and those which will undergo modernization. Another function of this department will be to foster a closer-relationship between General Electric and the building industry. Under the heading "Building Industry" we include everyone from the private builder, the architect, the operative builder, straight through to the financial services involved, which will, in many instances, include the Federal Housing Administration, the governmental branch set up to insure loans made to home owners. We are also going to set up a central clearing house which will render architectural service to prospective customers. It will work directly with the architects and aid them in their efforts to build into the homes which they have designed, those essential principles which were proved practical and desirable through our New American building efforts.

Under the General Electric Home Bureau will come Houses, Inc., of which Mr. Carl Snyder is the president. This department will be constantly occupied with matters of research related to the broad subject of improved home construction methods and materials. Also, Houses, Inc., will have to do with the future design of our products, working toward a closer relationship between our appliance design, and the "Use Sequence" principle which goes into the home.

During the experimental period, not all of the houses erected followed the plans of our architectural competition. It was not deemed advisable to place restrictions on the architect or builder, or force him to adopt one of our approved plans. All we asked of him as I have stated before, was that the house that he did build, would incorporate the specific General Electric appliances in order to qualify as New American. During the coming year, we are going to stress more heavily the manitenance of an architectural ideal. The houses erected from now on must be true and living examples of the New American idea. We have proved to ourselves that the New American house comes as close to the core of human interest as anything existant to-day. I do not know the motor show figures, but I feel certain that the showing of new models of cars did not attract a greater number of people than did the showing of our New American houses. Because these houses hold such great interest, we must do everything to assure ourselves that they are built in such a manner and equipped so thoroughly that the general public will view them with a thrill and will leave them with a permanent impression as well as the urge to possess.

A year ago, we brought forth the idea of a house which was planned from the inside. The builder could use an external design according to his particular fancy. As long as the interior conformed to the New American idea, the external might be Georgian, Modern, French Provincial, English, Spanish, or what have you. This coming year we are going a step farther. We are going to take into consideration that a house which might be eminently fitted to stand in an elm shadded New England town might be a hideous eyesore against the sun drenched hills of Arizona; that a gem of Spanish architecture which would grace a California town could be a hideous thing in a crowded New York State suburban area. Architects tell us that the United States may be divided up into seven architectural areas. We propose through close co-operation with the A.I.A. chapters in each locality where a New American house is projected, to see to it that the house there erected fits in with its locality and conforms to the local building style, custom and tradition. Further, we are going to assure ourselves that the demonstration homes which will be erected this year are of a high quality and possess the character which we desire. They are not going to be model homes, because a model is a miniature representation of a thing. Our New American homes this year are to be ample in size, thoroughly livable, examples of the finest in modern building thought and practice. We have taken steps to assure our

control of these houses that they may more closely approach perfection from every angle. We prefer to concentrate on and control a comparative few rather than to spread our efforts and give incomplete and hasty service to the many. In order to maintain this control, we are enlisting the co-operation of architects and doing everything possible to work in closer conjunction with the local chapter of the American Institute of Architects, the A.I.A. Thus directly we are assisting in bringing work into the local architect's offices.

After the decision to build has been made and the architect has drawn up his plans, he naturally will have specified various materials for the house. We will then call together the allied manufacturers who have equipment specified, or their representatives in each area, and invite their co-operation. It is obvious that these manufacturers and their sales agencies will be most eager to become part of our building program. We shall invite them to participate in our promotional effort which includes local advertising. As you will see, because the materials have been specified by the local architect, we are automatically freed from any charges of favoritism. We do not influence the builder in any way except as our own products are concerned.

In the case of the operative builder, when the plans of a house which he proposes to build are approved by the A.I.A. of that area, and the prices of the material are agreed upon, we assure him of our participation in local advertising. Thus we go to him with a definite, tangible proposition. There are no variables and no confused contingent clauses in our proposition to him. He knows definitely what he can expect and what he will get. Thus we eliminate any possibility of misunderstanding and confusion, either during the process of building or after the building is completed. We do not intend to grant nor do we believe it will be necessary to grant unusual terms or discounts. Having engineered and planned a definite General Electric layout of equipment, one flat price will be pre-arranged and will be agreed upon by our sales outlet.

Of course there will be many causes for exceptions to our rules. We know this and therefore it is our intention to keep our general plan flexible. We wish to do nothing to discourage or exclude the builder from co-operation. The only rigid portion of our plan is the basic requirement and that is that each New American house shall include the specified number of General Electric appliances. There are only two other requirements, the incorporation of "Use Sequence" and—the builder will permit the house to be used for demonstration purposes for at least one month.

It is quite possible that we will arrange a prize contest among the builders of New American homes during the next year. Just what form this contest will take we do not know at this time, but its aim will be to encourage and reward those who make the finest contribution to the furtherance of the ideals of the New American house building program. Of course we will continue our advertising and we anticipate quite as

much editorial interest and specific attention next year as we received during the year past. During the formative period of our activities for next year, we expect to organize a temporary field force. The personnel of this force will consist of men especially fitted either by experience or training to promote the New American idea in the field. It will be their work to maintain contacts with local chapters of the A.I.A., with the local builder and the local sales outlets and purveyors of building material to be used in these houses. Also they will aid in knitting together and making more successful the work of the local committees. From this you will see that we intend to pursue our promotional work for the New American houses vigorously and effectively during this year. Our experimental period is past and we may count on definite results from our effort, during this year.

To present the New American project in the terms of load building, to look at it from the standpoint of the utility, I am certain that you will agree that there has been no contribution of greater value in stimulating the more wide use of electricity than General Electric's New American plan. I think that it was in 1925 when Mr. Owen Young said, speaking on the condition of our industry "Only one danger confronts us. The danger is that the growth of our industry will outrun public understanding. . . that people will see and feel our size without understanding our service." To my mind General Electric's New American project has done much to give the public a better understanding of all that the electric industry has to offer toward the improvement of living conditions and the maintenance of everyday existence on a new high scale, which admits *leisure as well as luxury* as essentials.

I think that there is no more sure or more direct road to a better understanding and comprehension by the public of the part that the electrical industry plays in modern life, than over the route of practical demonstration by means of the electrical house. It is clear, obvious, that the elevation of living standards is solely and directly an electrical contribution. Take electricity from a New American house and what is left? A better insulated shell, certainly, a better planned house, but even superior planning is useless from the standpoint of "Use Sequence" if the essential appliances are not there. There can be no doubt of it, these "New American" demonstration houses have brought better understanding to the public of the interrelation of the electrical industry and our modern civilization. As for the direct benefits to the power generating industry, the connection is so direct that I do not need to dwell on this. Each house containing a complete electric kitchen; air conditioning, which in your climate means winter heating only; laundry equipment, the numerous small appliances, as well as the lighting equipment, is a valuable addition to any power line. Multiply the load drawn by thousands —and tens of thousands, and the increase in load the consequent revenue becomes great.

I am told that the Dominion also is on the verge of a building boom. Here, where the saturation of basic

appliances such as the range is five times greater than across the border, where the electric water heater saturation is ten times greater than in the States, the mind of your public is conditioned and ready for the all-electric house.

I do not believe that I need to talk further on the subject of advantage and opportunity to the utility industry of Canada latent in "New American" house promotion. We went through the experimental period, and possibly our experience may furnish some elements which will be of value to you in the promotion which you will undertake.

The "New American" idea is spreading. Recently I have had inquiries from both South America and Mexico. I can vision a not far distant time when all the Americas take up the "New American" idea. It's a logical and timely step, for house building means load building —and you, I know, are interested in load building.

* * * *

Canadian General Electric Co., Ltd. launched a similar program in Canada in August, 1935. C.G.E. did not conduct a competition among Canadian architects because it was felt there was sufficiently similarity between standards of living and home design as between Canada and the United States, that the results of the American competition were fairly indicative of what a Canadian competition would bring forth.

Canadian General Electric, therefore, organized to interest Canadian architects and home builders in the construction of homes equipped with labour-saving electrical devices, including planned kitchens, planned wiring, planned lighting and automatic heating and air conditioning. The suggestion was well received by Canadian architects and builders and at the end of the year 1935 a considerable number of such homes were under construction in Montreal, Ottawa, Toronto and other cities.

Canadian General Electric also has organized a home bureau to foster closer relationship with the building industry, including the architect, the private builder, the operative builder, thefi nance companies and the Dominion Government housing administration.

Alexander Development, Nipigon River.

Public Relations

By W. J. Cairns, Division Manager, The Bell Telephone Company of Canada, Toronto.

(Address to Association of Municipal Electrical Utilities at Toronto, January 30, 1936.)

IT has been said it is a good thing for us, or shall I say, a bad thing for us, when we stop learning. I was very glad this morning to find I was still learning something. And that was this, that this depression that we have talked a lot about in the last four or five years has had a different effect, so far as the Hydro Commission and Hydro people is concerned. I noticed that Mr. Jeffrey said you hit the depression. That is the first outfit I have heard of that hit the depression. I have heard a lot of them complaining that the depression hit them. I congratulate you, Gentlemen, on your achievement.

I remember when I was a boy—it wasn't on the farm, I wasn't fortunate enough to be born and brought up on the farm—in our home at Christmas time, if we were lucky, we had roast turkey. And I enjoyed it, as any normal, healthy boy would. But I believe the meal I enjoyed the best was the next day, when mother warmed the turkey carcass over and the stuffing—it wasn't dressing—and the turnip and the boiled onions and the potatoes. I still have a strong weakness, as the Irishman said, for warmed over potatoes.

Apparently, you gentlemen share with me that feeling, because you have asked me to warm over that talk of mine and give it to you again to-day.

I want to talk to you about Relations. You know the old saying, "God gives us our relations, but we choose our own friends," but these relations that I want to talk to you about—well, how shall I say it? The man who is fortunate enough in his domestic life and in his home to have no poor relations is indeed a fortunate man. So may we say about the public utility man, if his public relations are not poor relations, even though God may give us our relations he does not give us our public relations, and it is up to us in our capacity as Commissioners or Managers, or whatever it may be, that we should make them ourselves.

Now, I hesitate with a group such as yours, to tell you anything as to what you should do about your public relations. It is rather presumptuous on my part. You might feel like the small boy I heard about this week. You may have heard the story, but it is new to me. It was told of one of the well known ministers in our church, by himself. He was in a town in Western Ontario where he was to lecture. During the day he wanted to go to the post office. He wasn't sure where it was and on the street he asked a small boy if he would be good enough to tell him where the post office was. The boy said, "Sure, if you come with me, I will take you there." He was very grateful and offered the boy a small sum of money.

He said, "No, Sir, I would rather not." The Minister said, "I would like to do something for you. Here is a ticket I will gladly give you that will admit you to a lecture, at such a place tonight." The boy said, "What is the lecture?" The Minister said, "The Road to Heaven." The boy said, "Hell, you don't know the way to the post office. Why should I go to the lecture to hear you tell us the road to Heaven?"

It may be that you fellows think I don't know the road to the post office, and perhaps I don't.

You will recall, many of you, not so very many years ago, when public relations did not occupy very much of the attention of public utilities, or public corporations. I don't know whether Vanderbilt ever did say, "The public be damned"—I see one of our debunkers said he didn't—nevertheless that expression was pretty well indicative of the attitude of mind of the average official or executive of the large public corporations. It was their money they had put in it and they were charging their price, and the people were darned lucky to get a chance to use their facilities, whatever they might be. But a change came over the spirit of the scene. I don't know whether government regulations started to come into effect or not, but somebody wakened up to the fact that public relations were poor and something ought to be done about it and then we had in our public utilities, the Public Relations Departments. Oh, what a department that was. Did anything go wrong? Was it something about a right of way? What about some fellow who was raising old Ned in a certain section of the country—somebody from the Public Relations Department was sent for post haste to come down and Mr. Fixit was sent down in order to straighten this fellow out. Nobody ever thought the poor Manager on the job was capable of doing that. Or, better than that, nobody seemed to think something might be done at the beginning of things and avoid letting that fellow get hot and bothered over what was happening to him in his relations to the company.

We have got over that. I don't know whether generally so, but Public Relations Departments certainly do not exist as they did in the days to which I have reference.

I have in mind a little incident I came in contact with myself, which reminds me of the Public Relations Departments. It happened many years ago, long enough that I can tell it with safety now. In a certain city in Ontario, a certain company was having difficulty with their dealings with the civic authorities. It was a matter of a franchise and the Public Relations man went to visit the Editor of a certain newspaper in order that he might tell him the company's side of the case, which he did very eloquently and, apparently, forcibly because the Editor said, "Well, I do not feel that I favour your company but I am open to conviction." At that time I withdrew because I thought I would leave them to do the "convicting." He apparently succeeded all right enough, because the Editor changed his mind.

But now we have found it better that public relations should be taken care of right at their source. When

Mr. Public, his wife, or even the small member of his family comes to the office of the public utility and there meets that kindly, sympathetic reception that warms his or her heart and makes them feel that they are glad that they are doing business with that organization—that is what we call good public relations.

Publicity, of course, is a necessary thing. I think it is very important in the question of our rates, and I think it applies to your Hydro as well, that people should understand, as much as it is possible to have them understand, concerning the whys and the wherefors of rates. I presume the same applies in your case as in ours, you cannot point to a certain specific piece of equipment and say the rates you charge for the service in that regard pays you or does not, but your rate structure is built, as ours is, on the general proposition with as fair and equitable, as is possible, distribution of the rates.

But I am not speaking so much of the rates, but all the regulations and rules absolutely necessary in order that a business, a public utility, may be properly conducted, it is important that the people who deal with you know why it is that certain regulations are in effect and so your publicity will help you to do that, but be careful that your publicity, good and all as it may be, is not spoiled by a clerk in your office not knowing anything about it because you can get away from this fact, that your service is just as good as your customers think it is and no better. To the man who has trouble in dealing with the most obscure, most apparently unimportant clerk in your office, all the charts, all the advertising, and publicity in the world will have nothing but an antagonistic effect on that man as he remembers the little contact he had on that occasion. That, to him, is your public utility, and you may talk to him all you like, unless you explain away that incident, the publicity means nothing to him at all.

Now, in the matter of good public relations, there are two factors, shall I say? There is the Management and then the employees of the company and I don't know which is most important, after all. I will say this, that unless the Manager, the individual Manager in the town or city, representing that corporation, is thoroughly seized and imbued with the spirit of service, his clerks or his employees will never get it, because they may faithfully carry out his or the Company's instructions, but it will be in an automatical, mechanical fashion, and people, even though they may not be able to analyze it, are quick to sense insincerity and they will resent it and perhaps not be able to tell you why, and because they can't tell you why, they are just that much more antagonistic and just that much more sore in their feelings toward you and the utility you represent. So, it is very important that the Manager, first of all, be thoroughly saturated with a desire, a personal desire, to please the people with whom he deals, to have good relations with them and when he has, it is amazing how quickly the staff will catch from him that spirit.

I was glad that Mr. Jeffrey emphasized sales, because I do think, Gentlemen, that in sales you have one

splendid way of enhancing and improving your public relations, always providing, of course, that you keep away from high pressure stuff, but you feel, as he outlined to you, the different appliances you have that, they are all good for the housewife and for her husband as well, and he and she should have these improvements in their home, these things that make for comfort.

I think we are getting away from, and you don't hear nearly so much of it now, people saying, "Well, father didn't have those things. They didn't have those things on the farm. I think we can do without them, too." I think they have gotten over that. The comforts are there, if you can supply them at a reasonable cost you are doing a good turn by bringing them to their attention and giving them the opportunity to buy, and I say you are failing in your duty as a Manager if you do not bring those things to their attention, and consequently, the public relations are going to suffer because you have failed in that thing.

I would like to tell you what we do in our company. We lay stress on what we call the "everybody selling plan." We urge it on every one of our employees, down to the janitors in the building, because they have their friends with whom they come in contact day in and day out, and we urge them to suggest to their friends that they take advantage of telephone service, the auxiliary services, perhaps more particularly, and not to miss an opportunity to speak of these things to their friends. We don't want them to make a nuisance of themselves or a bore, and if they have any difficulty in speaking to friends, when they think the friend ought ot have some special equipment that they have not, they will tell us about it and we follow it up. We don't give any prizes for that but we do, by all manner and means, keep the matter before our employees. We have contests. We do give emblems to the districts that make the best showing in this enthusiasm, and things such as that to encourage our employees and we constantly keep before them this thing, reminding them, after all, it is their job and the more telephone equipment sold, the better pleased the customers will be, and the better will be the revenue of the company, which in turn will work to their advantage.

In that way we have a good means of maintaining a good esprit de corps in our staff and certainly we have found it a very excellent way of making a pleasing contact with our customers and establishing better relations with them.

Now, I don't like to make comparisons. We do feel, of course, in our particular business, as a public utility, that we have a slightly different problem from yours, and yet, after all, it is not so much different. I am sure you will pardon me if I speak about what we are doing, while I do speak of it from the angle of telephone service, practically all that I will have to say to you, I feel quite certain can equally apply to your business. You, as we, are manufacturers. You are manufacturing your service every day, and even as the manufacturer of a staple article must carefully watch to see that the quality in his goods is kept up, so we must with our

service. Many, apparently well established manufacturing concerns have gone to the wall, simply because those at the head thought they had become so firmly established with the quality of their goods, that they got a little selfish, thought they could skimp on the quality, and get away with it and nobody would notice. Perhaps they could do it for a while but people soon notice it and turn away from that concern. In many cases the manufacturer found, too late, that it was a sad mistake they had made.

And so, with our service and yours, eternal vigilance is the price of good relations. Public relations are founded on that, for after all, anything else I may say is predicated on the supposition that you are giving first of all good service to your people.

In our business we have three phases of our service. First of all, the installation of the equipment, placing it ready for the subscriber, that he may use the telephone. Then there comes the service itself, now changing its complexion quite considerably with the introduction of the dial telephone, but still remaining a personal matter, very largely, because even with the complete installation of dials, we have that now almost in Toronto—it will be complete within the next year or so—we still will need a great number of operators to assist people in dialing with their local calls, to handle their calls on information and, of course, with the long distance. A small part of long distance calling is handled by dial, but a very small part, and so far as I can see with my limited knowledge of the business, we are a long way off from anything approaching complete automatic in long distance business.

So, we have that phase where we must establish and keep good relations with our subscribers. For a long time we have paid very careful attention to that in the training of our operators, not alone to select a bright girl, one that is alert and that we felt would do a good job, but a girl with a good voice and we have maintained, in fact we still maintain classes in voice culture where we train the girls in the proper enunciation, the proper accent and the proper tonal quality of their voice.

With the telephone occupying, as it does, such a very important part in business life, I feel that business houses in general might very well pay a great deal more attention to those things than what they do to-day.

Might I just interject here that I do feel, as far as we are concerned in the telephone business, that in our public relations we have a lot to do yet in teaching our subscribers their responsibility in this regard. I don't think even to-day, the average business house is alive, thoroughly alive, to the value of the telephone to them in their good public relations with their customers.

Take, for example, the store that specializes, and which probably has a particularly wealthy clientele. Mrs. Gotrocks drives up to the store some morning in her limousine. There is a great hurrying around in the store to see that the best clerk available shall wait on Mrs. Gotrocks, to see that she shall get the very best attention and service. Very good. While this goes on, the telephone rings and Mrs. Gotmorerocks calls from her

home with an order. What happens? "Somebody answer that telephone. See what it is." Fortunate for the proprietor if the clerk who goes to the telephone has some sense of the importance that may be in that particular telephone call. I hope to live to see the day when business houses in general will awaken to the value there is in paying more careful attention to this very important matter.

Just this morning, in one of the morning papers, in the Women's Column, I see the woman who writes there says, "I, whether rightly or wrongly, find I judge the status of the firm I am talking to by the way I am answered on their telephone," and she goes on to say, "I do think it would pay many of your executives to listen in occasionally and hear what is going on in and out through the switch-board and the telephone of their business."

I submit that to you, Gentlemen, as being an important thing in your business, because these ranges and heaters and the like that you are selling, that Mr. Jeffrey talks about, I guarantee, in many cases might be sold by telephone by just a little finer and closer attention to the value of courteous, friendly, sympathetic service, given to your customers in that way.

But I want to tell you particularly—because this is public relations—all the things I spoke of, the operators are important, but so are the installers. We train our installers to be careful in their behaviour in the premises of the subscriber, in the private house, particularly, just as much so in a store, that they shall make as little muss as possible, that they shall be very careful to clean it up before they leave. If he borrows a step ladder or anything like that, he must put it back where he got it, and those little things that gladden the heart of the housewife, because Heavens knows, she never can get her husband to do those things, and it does make her joyous to have a man come in the house who is thoughtful in that way. These little things count and the housewife will judge the company she is dealing with by the actions of that man.

I have spoken of the operators and the important part they play and how carefully we try to train them so that they may be courteous and attentive to their subscribers. But I wanted to pay more particular attention to the training of our business office people, the contact they make with a subscriber taking his order, to be careful to get full particulars from him, that there may not be a misunderstanding. It is so annoying if you go in and order a certain piece of equipment and you think you have cleaned the whole matter up and then the next day, a man comes along and you find a mistake was made. This applies equally to your installations. The clerk has the thing wrong. Perhaps before you catch it, the man has started the work altogether in variance with what you want. Picture, if you will, the housewife's state of mind in that case. We urge on our people the importance of being sure. When we tell the person we will put in that telephone tomorrow or the next day, we ask, "Will there be someone there at any time in the day in order to show the man where you

want the instrument?" If the customer says there will be no one there in the morning, very well, we will arrange that the man should go there in the afternoon.

These things that seems so small, so trivial in themselves, may mean so much in smoothing out the way of our relations with our subscribers.

There is the matter of his entry in the directory. If telephone managers go to an early grave, one of the principle causes is the errors that creep into the directory. I leave it to your imagination, if it happens to be your entry, the name is wrong, the name spelled wrong, and the number wrong, it doesn't matter what a lovely book it is in every other respect, to you that book is no good. There is nothing else to it.

So, first of all, in selecting our clerks, let me say this: we have what we call service representative plan in the organization of our offices. We give to them a certain number of subscribers that they are responsible for in all their relations with the company (excepting the reporting for repairs), the billing and the collections, if there are any changes in equipment, or anything like that, the subscriber is always directed to this same clerk. We have found, generally speaking, it is more satisfactory that we should have girls for that work and we are extra fussy, shall I say, in the selection of those girls. Sometimes I wonder if we will ever get to the point where we have learned all the things we need to learn in helping us to make a good selection. Only this year, since the beginning of it, we have introduced some refinements in the matter of choosing the girls we take on for this particular work. We use a couple of intelligence tests we have found to be very good, not necessarily the last word. These girls pass through the hands, first of all, of a woman whose business it is to make the selection. She is selected because she knows our business and because she is sympathetic and kindly to the girls in her reception of them. And then a couple of other officials pass on the qualifications of these girls before we finally say "All right."

Then, before we allow them to use the telephone in dealing with the public they have at least two months training in a school where six of them are put under one teacher who puts them through what we call "case work," so they go through all the motions, all the doings likely to come under their care when they actually assume their position in the public office and then, even with that, they will make mistakes, but as I view the result, I hark back in my mind to the old days and I think of the many business houses today who rely so much on the telephone for handling their business, getting the orders, and I shudder as I think of the utter lack of training that is given to clerks who are assigned to that particular duty.

There is no use of our complaining about the telephone and saying that we would a darned sight sooner they would come in our store. Perhaps we would. But they won't. I am not here to apologize for the telephone, but it is here and we have to make the best of it.

Now, having given our people the mechanics of the job, the rules and the routine, we strive in every way we

can to give, as I have said already, the spirit of this thing, that they should try to remember the circumstances surrounding this customer who comes to them.

He has come to the telephone company, even as he would come to your utility. It is a large corporation. He realizes he is an infinitesmal part of their group of customers. He wonders if the thing he is going to ask for is not, perhaps, at variance with their rules. In other words, he has a very well developed inferiority complex and because he has that he instinctively assumes an aggressive attitude. He bristles a little bit, not meaning to, but he throws out those defences because he feels he has to do it. Then, picture that man when he comes into the office or calls on the telephone and hears a warm, sympathetic voice, which says, "I am here to help you. I am interested in the thing you want and I am going to try as best I can to give it to you." How that man's defences come down! And, as I say to my people, the battle is half won. You have that man's confidence.

I do not hesitate to tell my people, "Don't hesitate to appeal to a man's sense of importance." Did you ever think that is why the home is such an important place for you? You are an important individual in the home. That is why we say to a man, "We want you to feel at home." We want him to feel that that office is built and designed and we are there that particular morning in order to do business with him.

Do you remember how the hotels used to be, when you went to the large city hotel you were made to feel so small that there was not a hole small enough in that place to crawl into. You begged that clerk to be kind enough to listen to your plea and if he gave you a room he did it in a way that made you feel you ought to get down on your knees and thank the good Lord that he was going to let you have that room. The hotels found it didn't pay. What happens to-day is that you just feel that hotel was built to be ready with a nice room, comfortable, with all you want in it ready for you, because you came that night and you are conferring a favour on them. They don't overdo the thing. They appeal to your sense of importance. You are something to them and you like it and you want to do business with those people.

I submit that will apply to the Hydro-Electric, as it does the hotel, and we have found it does with the telephone company.

We try to train our people, as I said to the group here last year, in the three R's. I told this to a group of school teachers and I heard one of them snort, "Here it comes again—the three R's." I had a new three—to Reason, to Reciprocate, and to Remember. I think they are important things for any clerk or any person who is dealing with the public.

To Reason: I mean by that you have reason for doing things, a reason for the rules under which you must give service to that particular customer.

To Reciprocate: I have touched on that. You are going to give and take with him. Come down, if you will; come up, it may be, to his level. You are going to interchange with him. He has business to offer you,

he has money to offer you. You have something to offer him in return. You are going to reciprocate with all that word means.

To Remember: You are going to concentrate on his particular order. I have said to our people, over and over again, "I want you to feel, when you are dealing with this customer that you are giving him the feeling that the most important thing you have to do in life is to take care of his wants." That is what it should be. Everything else is pushed aside for the minute. That is your business.

That applies to any of us in dealing with a customer. If you are going to be successful, you must concentrate on that particular contact and for the time being nothing will let your attention wander, for if you do how quick the customer will seize on that, and he realizes then that you don't care, you are not bothered about what he wants and your whole thought is to get rid of him, to get on with something of more importance, and certainly you are not appealing to his sense of importance when you treat him in that way.

So, if your employees can be taught the three R's, I feel you are going a long way in building up and establishing good public relations.

We try to appeal to our people on three points in the training of them: What you have to do, why you do it, and then, how you do it.

I think, Gentlemen, I don't need to dwell on these, the importance of them, and how they will cover almost any contact that you may have with customers.

And, then, this all important thing, when a man has a complaint, to listen patiently to all his story. I told our girls that there is many a girl who has got a good husband because she is a good listener. Any man likes to talk about himself, particularly, and happy is the girl who sits and smiles and listens while he does it.

Did you ever stop to think, how often you have left some man and thought how clever he was. If you stop to think, you find that he said very little, but how he did listen to you. If a man has a marvellous command of the English language, sit and listen to all he has to say, and I am almost mean enough to say it is a good idea to let him talk himself out. You will have him on the end of a limb and he may forget it. If you are impatient, brush aside what he has to say, then he resents that. He resents any feeling that you think you know more about it than he does. He should be made to feel that he and the Almighty are the only ones who know all about it.

Of course, I say, don't argue. Did you ever stop to think of all the arguments used, did you ever hear one that amounted to anything, except when they were finished, you say, "By gosh, I put it over that bird," and he went away thinking he had done the same thing. Even though we may resent the criticism of our customers, perhaps the criticism is unjust, listen patiently and if we are wrong, particularly, admit it quickly. O, what a world of trouble and argument and everything else it would save us if we would quickly say, "I am sorry. We did do wrong." I have told my people it doesn't hurt to say you are sorry when what you mean is you are sorry he doesn't

know any better, but you have told him you are sorry and that registers with him.

I have told how important it is that our clerks hearing the complaint should quickly admit an error on our part. We are human, we make mistakes. You have taken half the sting out of the complaint when you admit it. Having done that, the next move is to take quick action. Not, "I am going to pass this over to such a Department," but "We are to blame and I will see it is made right for you."

Now, I just want to add one or two things and I am through. People are the most interesting things in the world. I say to our people you have the most interesting job in the world and the greatest job in the world in dealing with people. I urge upon them to study people. I have told them this, "You will be surprised as you study the customers who come to you by telephone or otherwise. Check up and see how you are able to size them up because no two people are alike and you will be surprised how in a comparatively short time you are able to judge people pretty well." It is a fascinating game; after all, why can't we make our job in the nature of a game? There is no reason why we should make it onerous.

I was talking last night to a well known man. He said, "The Puritanical training is still in our blood. Instinctively we feel that anything we like, there must be something wrong with it." Why can't we throw ourselves into our job and make a game of it? Isn't it a fine thing to be dealing with the people who come to you with complaint? You mould them and straighten them out. The man who comes in hot, you cool off and send out, feeling it is a good thing he met you. I don't know of any more wonderful game there is in this business world than that of dealing with people and handling them in that way. Isn't it a great thing to think we can make that contribution to the community? I don't care how large or small the community may be, you are by reason of your dealings with your customers and the service you are giving them, making them happy and contented. Aren't you doing infinitely more than that old saying of making two blades of grass grow where one grew before? You have uplifted the tone of the community, you send men and women home in a happier frame of mind and who can tell what a difference you have made in that home? There is no end to what can come of it.

I read in an American city how, because a certain man kissed his wife in the morning he averted a strike. She was kind of surprised and pleased. It put her in a happy frame of mind. She was a little kindlier in her dealings with the maid, and the maid, in turn, was a little kinder to the ice man. The ice man felt the impact of her smile and went out and in his dealings with the men he came in contact with, he felt kindlier to them, and so it travelled and reached the home of a man at the head of a group of men who had decided that that day a great industrial strike would be started, and believe me, the effect of that man's kiss worked on the strike leader, eventually, and the strike was called off.

Isn't it a great thing to think in your public relations that we are going, perhaps, to make our contribution to our city and community in that way?

I have said in my capacity as the Manager of the Telephone Company that in a day's work if I can make things so that there are even a few less wrong numbers, I have averted a lot of profanity and perhaps I have done as much good as a lot of ministers with their sermons.

I like to think of the job that way. I say it again, it is the greatest job in the world and what a pleasure it is, having done it that way, you have the people responding to your appeal to them, and you meet a man on the street and he says, "I was dealing with your office this morning. I was in there or telephoned and Miss or Mr. So-and-So was splendid in the way he treated me," then you feel, depression or no depression, things are not so bad after all.

A.M.E.U.
Convention Notes

The convention of the Association of Municipal Electrical Utilities, which was held concurrently with the Annual Meeting of the Ontario Municipal Electric Association at Toronto on January 29th and 30th, 1936, set a new record for attendance of delegates at these conventions. The convention registers show a total attendance for the two Associations of approximately 500.

Papers and addresses given during the convention are reproduced in this and the January and February numbers of The Bulletin.

The following were elected officers for the year 1936:—

President—C. A. Walters, Napanee.

Vice-President—H. F. Shearer, Welland.

Secretary—S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

Treasurer—W. B. Munro, H.E.P.C. of Ontario, Toronto.

Directors (from the membership at large)—G. E. Chase, Bowmanville; O. H. Scott, Belleville, and W. H. Childs, Hamilton.

District Directors:

Niagara District—R. S. Reynolds, Chatham.

Central District—R. O. Quick, Brighton.

Georgian Bay District—C. E. Brown, Meaford.

Eastern District—A. L. Farquharson, Brockville.

Northern District—C. J. Moors, Fort William.

The recommendation from the Executive Committee that the summer convention this year be held at Ottawa on July 2nd and 3rd, 1936, was approved.

Two resolutions were passed during the proceedings. Following a verbal report by the Chairman of the Rates Committee in which he outlined work that had been done during the last two years, towards getting a revised Standard Interpretations of Rates, it was regularly moved and seconded, and carried—That this Association recommend to the Ontario Municipal Electric Association that they use their efforts to have the Standard Interpretations of Rates revised in accordance with present operating conditions. Also after the paper by C.

E. Schwenger—"The Present Trend in Service Entrance Practice," it was moved and seconded, and carried THAT this Association places itself on record as favouring the use of suitable cable for domestic service entrances, and in view of the saving that will result from the use of such cable, it is recommended that the municipalities absorb the cost of the same as part of the distribution capital.

At the Executive Committee meeting held on the evening of January 29th, Committees were appointed as follows:—

PAPERS COMMITTEE—Messrs. R. S. Reynolds, Chatham, Chairman; E. V. Buchanan, London; G. F. Dean, Toronto; M. J. McHenry, Canadian General Electric Company, Toronto; C. W. Hookway, Canadian Westinghouse Company, Toronto; H. D. Rothwell, and W. B. Buchanan, H.E.P.C. of Ontario, Toronto.

CONVENTION COMMITTEE—Messrs. H. F. Shearer, Welland, Chairman; J. W. Peart, St. Thomas; J. E. B. Phelps, Sarnia; G. E. Pennock, Ottawa; W. E. Ressor, Lindsay; F. Mahoney, Canadian General Electric Company, Toronto; C. H. Hopper, Ferranti Electric, Toronto; G. F. Drewry and B. Mulholland, H.E.P.C. of Ontario, Toronto.

REGULATIONS AND STANDARDS, COMMITTEE—Messrs. C. E. Brown, Meaford, Chairman; R. J. Smith. Perth; F. W. Peasnell, Toronto; R. L, Dobbin, Peterborough; J. Eckersley; Toronto; A. B. Manson, Stratford W. P. Dobson, H.E.P.C. of Ontario, Toronto, and A. G. Hall, Electrical Inspection Department, Toronto.

COMMITTEE ON ACCIDENT PREVENTION AND HEALTH PROMOTION—Messrs. A. L. Farquharson, Brockville, Chairman; C. E. Schwenger, Toronto; R. S. Reynolds, Chatham; J. W. Peart, St. Thomas; R. Harrison, Scarborough Township; V. A. McKillop, London; F. D. Hubbell, Windsor; R. L. Dobbin, Peterborough; T. C. James, G. F. Drewry, E. R. Lawler and Wills Maclachlan, H.E.P.C. of Ontario, Toronto.

MERCHANDISING COMMITTEE—Messrs. O. H. Scott, Belleville, Chairman; H. R. Hatcher, Galt; A. B. Manson, Stratford; J. E. B. Phelps, Sarnia; I. N. Pritchard, Chatham; F. S. Rhoads, Windsor; A. W. J. Stewart, Toronto; O. C. Thal, Kitchener; R. W. Turner, Hamilton and G. J. Mickler, H.E.P.C. of Ontario, Toronto.

RATES COMMITTEE—Messrs. G. E. Chase, Bowmanville, Chairman; P. B. Yates, St. Catharines; O. H. Scott, Belleville; O. M. Perry, Windsor; R. S. Reynolds, Chatham; C. A. Walters, Napanee; T. R. C. Flint and F. W. Peasnell, Toronto; W. R. Catton, Brantford; J. J. Jeffrey, G. F. Drewry and S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

COMMITTEE ON ACCOUNTING AND OFFICE ADMINISTRATION—Messrs. W. H. Childs, Hamilton, Chairman; George Appleton, Toronto, Vice-Chairman; J. W. Bayliss, Niagara Falls; T. W. Houtby, Welland; A. B. Manson, Stratford; I. N. Pritchard, Chatham; W. E. Wallace, Windsor; R. S. King, Midland; W. M. Salter, Barrie; C. E. Brown, Meaford; M. W. Rogers, Carleton Place; H. Clegg, Peterborough; A. D. Nelson, Kingston; K. G. Starr, Brockville; G. E.

Pennock, Ottawa; R. M. Bond, H.E.P.C. of Ontario, Toronto.

AUDITORS—Messrs. H. P. L. Hillman, Toronto, and W. G. Pierdon, H.E.P.C. of Ontario, Toronto.

HYDRO ELECTRIC RANGE CAMPAIGN

ANNOUNCEMENT !

COMMENCING APRIL 15th, 1936

The Hydro Electric Range Campaign is off to a new start for 1936 — Every Hydro Municipality should

CO-OPERATE

To make this an outstanding campaign

Policies Recommended for Hydro Municipalities

1.—Finance Range Sales made by dealers.
2.—Favourable terms as to time and carrying charges.
3.—Three-Wire Service and Range Wiring installed at no cost to Consumer.
4.—Set a Quota for 1936. Say 10% of present ranges in use.
5.—Advertise Electric Cooking and the Range Campaign in co-operation with dealers.
6.—Arrange for Range Displays and Advertising Displays in Dealers Stores and Local Hydro Offices.

Policy adopted by Hydro-Electric Power Commission for Rural Consumers

1.—Financing Range Purchases up to three years.
2.—Low Financing Charge—4%.
3.—$20.00 allowance to Range Purchasers. Range must be new and over 60 amperes.
4.—Ranges can be purchased also on the Rural Loan Plan—along with other Equipment.
5.—Extensive Advertising and promotional work among Rural Consumers.

We urge every Hydro Municipality to support this campaign
LET US ALL GET TOGETHER AND PUSH IT

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
SALES DEPARTMENT

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The Place and Scope of Engineering in the Social Fabric

By A. Lennox Stanton, M.I. Mech. E., M.I.E.E., M.A.S.M.E.,
Fellow, Member of the British National Council

In the first issue of such a publication as "The Science Forum" it was essentially desirable that the first article on "Engineering" should cover as wide a field as possible in scope, and prove international in application. It is felt that those conditions have been fully met in the following article by Mr. A. Lennox Stanton, whose knowledge and experience is wide, diversified and international.

Of engineering literature, technical, descriptive, and specialised, there is no end, but of such literature which stimulates dimensional thought by presenting its subject through constructive channels based on the universal principles of Creative Design there is a shortage. This article falls within the latter category and therefore meets a need. Suffice to say, it must be read to be appreciated. In some respects it may be looked upon as a call to the combined engineering and science fraternities to recognise the simple truth, they do not yet fulfil the part they should, in moulding the well-being of a world Social Fabric, which would not exist in its present chaotic state, had that part been rightly fulfilled.—Editor, The Science Forum.

LO; WISDOM COMETH NOT SUDDENLY; ONLY AS DARKNESS GOETH AWAY DOES LIGHT FIND EXPRESSION. YET THE PROOFS EXIST ON EVERY HAND THAT ALL DWELL IN THE MIDST OF GREAT KNOWLEDGE; TO MAKE MEN PERCEIVE IT IS THE LABOUR OF GODS.

PRIMARILY, as is related to the world we live, move, and have being in, it should be self-evident, the earliest proofs of the "place and scope of engineering in the social fabric", were demonstrated at the time the conditions of creative endeavour had reached the stage which provided for the birthing, development, and

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MAY, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

maintenance of the first root races of man.

In so far as life on this planet is concerned, it is being realised slowly yet none the less surely, how it receives its primary rhythmic impulses through master vortex mechanisms over which man has no control.

With the sun at the head of a solar system or family of planets to which the earth itself belongs, the vortexial activity of the solar master vortex carries the planetary system through space as a single unit, having form even as the coils of a great serpent in motion.

Within the master vortex, yet inter-dependent upon it, each planet has a definitely assigned position, maintained by virtue of a sub-vortex, from which is derived in the case of the earth, its axial motion. This mechanism is supplemented on, over, and about the earth, by the subsidiary mechanism of the atmosphere, which is manifestly designed to maintain and condition the even more marvellous and concentrated mechanism of man himself.

Considered solely from its dynamic presentation and with a due regard for relative place, function, and scope, it will be clear, the whole presents an object lesson of large scale co-ordinated engineering in relation to the social fabric, which cannot be brought to mind too often, if constructive good is ever to establish its highest expression in the world's work.

It cannot be doubted, universally applicable base principles without which the correlated organic activity revealed could not function, hold good To-day even as in the Past.

Still less can it be doubted, but that those principles will continue to hold good, until the function for which a social fabric was brought into being on this planet, is fulfilled.

Related to the analogy presented by the foregoing, a looseness of application commonly found in × use of the terms "engineering" and "social fabric", has tended to obscure the all-important necessity for recognising that one cannot exist without the other.

Moreover, the higher the grade of the social fabric, the more advanced and organically "positioned" becomes the place and scope of engineering in it.

Being inter-dependent upon each other, they are linked by indissoluble bonds and possess a similar duality of objective, in that, the real value

of every engineering advance made, lies in the degree to which such advance proves of service to the social fabric when considered as a whole.

When the foregoing is realised as it yet must be in a future constructive thought age, it will bring about a new understanding of obligation between races and nations, breaking down barriers in realms of progressive endeavour which should never have been allowed to find expression.

Now ability to carry out "engineering" on earth implies an availability of intelligence, of labour, of power, of transport facility, and of raw and finished material, necessary and essential to and for the purpose in view.

Strangely enough, and entirely at variance with theories held, that the world is but a chance-wrought fraction of a greater molecular assembly from which it became detached; whenever the conditions of man have been ripe for discovery, production, and development, all the elements required for meeting the demand of a particular cycle of time have always proved available.

Rightly understood, this means, provided an unbroken ascendency of constructive thought is held in dominion and despite a great waste of natural resources continually in evidence, there never will come a time when the facilities for maintaining the social fabric will not be available.

Areas in which great populations are congregated will change; methods of design, materials for use, and functions fulfilled will advance; new modes and methods come into being; but the base principles of application which determine the place and scope of engineering in relation to the social fabric of generations yet unborn, will always provide evidence of a universality similar to that which now prevails.

Having travelled thus far, it is possible to indicate some measure of the place and scope of engineering in its relation to the present social fabric.

Compared with what is known of the world's work during the past two thousand years, the period since 1800 has recorded remarkable advances.

Prior to 1800, peoples in dominion knew little or nothing of the potentialities of their own lands, possessed no knowledge of engineering as interpreted to-day and the general conditions which prevailed everywhere, more or less prohibited all attempts to establish any foundation or school for the attainment of exact knowledge.

They were days when the use of water power was on primitive lines; when the working of known metals although highly skilled, was mainly by hand with an extremely limited range of tools.

Days of man and animal power with very restricted facilities for speedy transportation in bulk, either by land or water.

Architecture was coloured with tradition and custom; largely expressive of environment, it furthermore indicated by style and adaptation, both the place held in the social fabric and representative conditions of that fabric.

Economic mobility in the sense realised as possible to-day had no place in that social fabric, it could not in an age which knew not how to distinguish between real and apparent motion.

The advent of steam power changed a non-progressive engineering situation into one of unbounded and unlimited opportunity. Coal and iron became available at low cost, thus opening the door to facilities for cheaper and more rapid locomotion by land and water. The opening up of world markets followed, and thus was inaugurated the industrial age from which have emerged most of the existing factory systems, mass production and mass distribution methods of this day.

Even though it has meant a transference of manual skill to a machine, the great debt owing to the machine tool industry by the world's people will never be known.

The first half century of this industrial change expressed itself in the disfiguration of fair countrysides. Generals Smoke and Squalor came into authority and were given full charge, control of development being opportunist and individualist.

As yet, the orderliness of scientific management with trained workers having respect for attention to detail found no place.

In the rush which followed to secure monopolies of development, the changes brought about in the social fabric differed wherein they found expression in countries having an existing civilised fabric and those which had not.

For example, Europe was organic in the sense that the North American continent was not, during the inception of the industrial age. The position held by the United States in the world's work of to-day, is therefore more the result of the place and scope of engineering in its social fabric, than applies to any other land.

The last fifty years of the industrial development which has formed the outcome of an increasing recognition of the place and scope of engineering in the social fabric, has witnessed rapid advances made through the slow yet sure application of ordered thought, to securing a more efficient and beneficent distribution of the world's products to its consumers. It has seen the domain of pure physics harnessed to that of applied function and the conjoint development foreshadowed, will undoubtedly march along with an even greater rate of acceleration than any recorded in the past, provided civilisation maintains its foothold on the pathway of ascensional growth.

That the social fabric has not yet proved itself capable of utilising more advantageously, the vast surplus of everything that an increased power of production has rendered available for the good of man, is largely due to an inability to recognise the true place and scope of engineering in the fabric.

Of what avail an ability to transmute the energy of a ton of coal into the production of an equal quantity of high grade steel, if the conditions of distribution are such as negative the value of the accomplishment?

Of what avail an ability to transmute the energy of a pound of low grade fuel into the production of a kilowatt of electric service availability, if the conditions of that availability are such as prohibit the rural cottage and the farm from the "use" service value it possesses?

Of what avail high speed railway facilities, if the conditions of "use" prohibit the communities served from deriving any advantage therefrom?

The place and scope of engineering in the social fabric is so clearly defined in the every-day affairs of every walk of life, that no recapitulation of historical landmarks or of statistics is necessary to emphasise its reality.

To enlarge the scope and significance of that reality in the life of all the living, requires the fulfilment in the social fabric, of a wider and deeper function than is visualised by the limited processes of the daily task.

The end of the present century will find the engineer-scientist exercising a greater influence than ever before in the building up of new social fabrics, wherein the smoke and dust of past conflict and antagonism will be swept away.

Until that day comes, the true place and scope of engineering in the social fabric cannot be established in the fullness of its power for helping forward the nations of the earth.

Meanwhile, the immediate labour of the day requires a greater recognition among engineers and scientists, that although Engineering is an important part of the whole, nevertheless, its place is that of a servant to man and never that of a master.

An examination of existing conditions will also show, no greater form of mal-adjustment exists, that the common one of finding the scope of Engineering in the Social Fabric, invariably limited through its subjectivity to multifarious interests constantly striving to utilise it for selfish ends.

Better Lighting in Schools

By George G. Cousins, Testing Engineer in Charge, Illumination Laboratory, H.E.P.C. of Ontario

(Address to the Convention of the Urban School Trustees Association at Windsor, Ont., May 20, 1936)

DURING the last few years there has been a gradual awakening of interest in the part played by artificial lighting in the progress of children in schools and in the effect of bad lighting on the children themselves. During the present season that is approaching its end, the requests for recommendations for improved lighting have equalled in number the requests for many years past which seems to indicate that, at last, something is to be done about this most important matter that has been neglected to the detriment of all concerned, the pupils, the teachers, and those who pay for the operation of the schools.

Although lighting is the focus of attention it is only a means to an end which is "seeing". The real subject under discussion is therefore "Better Seeing in Schools". This broader subject involves more than the installation of lamps and fixtures and in the following discussion, attention will be given to some of the most important of these features of the problem all of which have a very definite relation to the problem of seeing and which, considered with lighting, will lead to a better appreciation of the problem as a whole.

Fundamental Requirements for Seeing

Nature has provided us with a seeing system that possesses certain characteristics; we cannot alter these characteristics but we, fortunately, know something of them and it is within our power to provide the conditions required by our eyes for their proper functioning.

Briefly stated, these fundamental requirements are:

1. The details to be seen must be above a minimum size as viewed by the eyes. Written or printed characters on a blackboard may appear small to a child seated 30 or more feet from them.
2. There must be sufficient contrast between the details and their background. Allegedly white chalk marks, which are actually light gray on an alleged blackboard which may be a moderately light gray are practical examples of limited contrast.
3. It takes time for the seeing system to see an object looked at. The time factor is most keenly felt under low levels of illumination intensity.

   Fig. 1 shows the relation between time required for seeing and illumination intensity. It

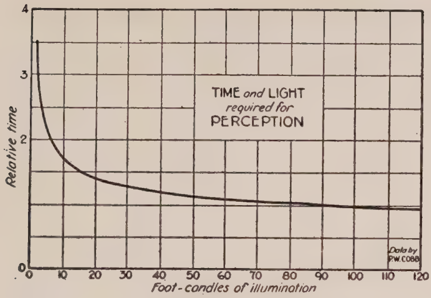


Fig. 1—It takes 3½ times as long for the eye to perceive a small test object under 2 foot-candles as it does under 100 foot-candles.

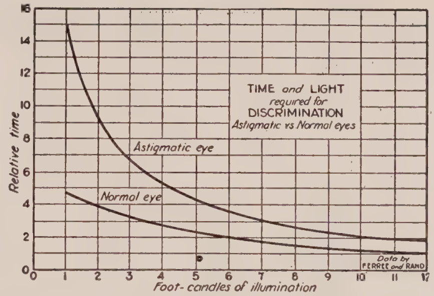


Fig. 2—Normal eyes increase in speed of discrimination 3½ to 1 between 1 and 12 foot-candles; astigmatic eyes show even more pronounced improvement.

will be noted that the relative time for 15 foot-candles, which is the recommended value for class rooms, is 1.5 and that the relative time for 2 foot-candles is 3.5. This means that under the illumination found in the dark sides of many rooms it requires nearly 2½ times as long to see an object as it does under the recommended intensity of illumination. This may seem a trivial matter but during this extra time required by low intensity the seeing system is using up energy that represents wasted effort. This curve shows the difference in the visual tasks of the children in the dark sides of the rooms as compared to those in the favored positions near the windows.

Fig. 2 goes a step farther to show that this condition is worse for defective eyes than for normal eyes. But note particularly that the improvement in seeing resulting from improvement in lighting is far greater for defective eyes than for normal eyes. At one foot-candle (found in many rooms) the astigmatic eyes require three times as much time as the normal eyes but that under 12 foot-candles, it requires only twice as much time as the normal eyes.

Poor lighting not only damages the eyes but this damage imposes an extra handicap on the seeing system.

4. Brightness of the object viewed influences the ease with which the details are discerned. For this reason dark objects are much more difficult to see than light ones under the same illumination intensity. Conversely, dark objects require higher intensity than light ones do.

These requirements all enter into the problem of seeing whether at school or elsewhere. If there is a deficiency in some respects, the others must be augmented or else the individual pays the price in eye strain, which if persisted in, leads to fatigue and finally to injury.

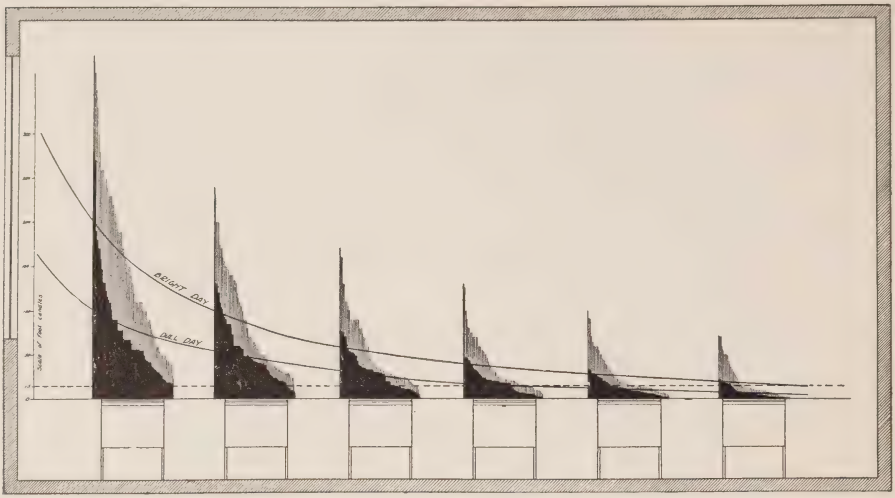


Fig. 3—Showing the rapid decrease in daylight illumination from the windows to the far side. The light shaded areas represent the intensities of illumination on clear days, the black areas represent dull days. The two curved lines represent the average values for clear and dull days.

Higher intensity, as compared to low, makes it—

Easier to see small details.

Easier to see details with low contrast with the background.

Easier to see quickly and more accurately.

Easier to see dark objects.

Daylight Illumination

When daylight enters rooms from windows in one side there is naturally a decrease in illumination intensity as the distance from the windows is increased. The amount of this decrease, however, is astonishing when the facts are presented. It varies in different rooms depending upon the extent of sky exposure visible from the side farthest from the windows and the brightness of the sky.

Fig. 3 shows the results of hundreds of measurements taken on desks during the past season. On dull days there is a general lower intensity, but attention is directed to the large percentage of bright day measurements that are below the recommended intensity of artificial lighting and to the fact that on the desks adjacent to the windows all of the dull-day measurements are above this recommended intensity. Records of the Meteorological Office at Toronto show that for a period of 40 years, the mean percentage of cloudy sky during the school months is 53. This applies to Toronto, but it is a reasonable assumption that the cloudy days represent about half of the school hours in Ontario. At five days per week this represents 20 whole weeks during which a substantial proportion (approaching half) of the pupils have to work under subnormal lighting.

Fig. 3 also shows that a considerable proportion of the pupils have inadequate lighting all of the time.

Some of this inadequate lighting is extremely low, being no better than the light from one candle. It is quite obvious that the children in these dark parts of the rooms are not provided with facilities for progress equal to those in the opposite sides of the rooms. This is an appalling situation particularly in view of the fact that 75 per cent. or over, of our knowledge is gained through the sense of sight.

When it is difficult to see easily, the natural tendency is to look more closely at the work so that larger images are formed on the retina of the eye. This requires continual tension of the muscles controlling the focus of the eyes which tires them. If this condition persists, the muscles become more or less fixed in this range of close adjustment and the eyes become permanently formed for short-sightedness. We have observed postures developed by this situation in a great many school rooms.

Present Artificial Lighting

Little need be said about the artificial lighting that schools are equipped with at present. With few exceptions they are far below an approach to reasonably effective levels of illumination and in many rooms the artificial lighting intensity was barely enough to disturb the pointer of the meter which was being used to measure it.

Types of Lighting

There are three types of lighting from which a choice may be made. Each one has its particular advantages and disadvantages and no one type should be selected without a knowledge of its characteristics.

Indirect Lighting

Totally indirect lighting is produced by fixtures containing a reflector that directs the light to the ceiling and all of the light that reaches the work plane must be reflected from the ceiling. This lighting is well diffused and is as nearly perfectly free from glare as artificial lighting produced by standardized fixtures can be. The only glare that might be produced by it is from excessive brightness of the ceiling but this would only occur when the units are suspended too close to the ceiling. It may be said, therefore, that it is practically glareless.

The ceiling reflects the light and it is essential that the ceiling be maintained in first class condition as a reflector. This requires white or nearly white color. Furthermore, indirect fixtures are usually of the open bowl type and these collect dust which, because it is out of sight, is very easily overlooked and unless regular and frequent cleaning is done the system will rapidly depreciate in efficiency.

Each time light strikes a surface some of it is lost by absorption and on this account indirect light is less efficient and it requires one size larger lamp for a required intensity of illumination than the other types of lighting do.

From the viewpoint of comfortable, easy seeing, indirect lighting is to be preferred but neglect to maintain the entire system in an efficient condition will soon destroy its merits.

Direct Lighting

Direct lighting as its name implies, distributes the most of the light onto the work plane without reflection from the ceiling or other surfaces. It

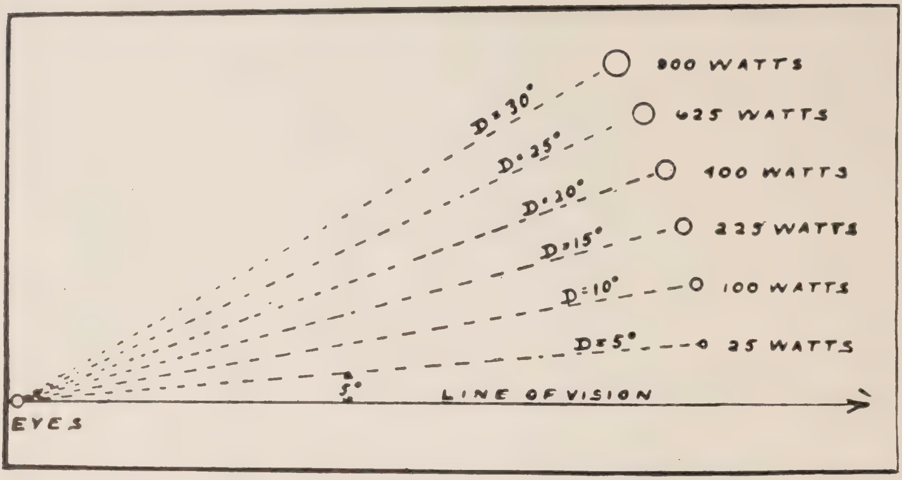


Fig. 4—Small lamp near the line of vision will cause as much glare as larger lamps farther from the line of vision.

is therefore the most efficient type and will produce a higher intensity of illumination with a given size of lamp than the other types will. Its chief disadvantage is the possibility of glare which may be of two forms, direct glare caused by the fixtures being in the normal line of vision and reflected glare caused by the fixtures themselves being reflected from glossy desk tops, books or blackboard.

An exposed light source within the field of view will cause some glare and to minimize its intensity the light source should be as far removed from the normal line of vision as is practicable. A low candle power lamp near the line of vision will cause as much glare as a higher power lamp farther from the line of vision, as shown by Fig. 4.

Direct glare can be minimized by mounting the fixtures high, this also reduces reflected glare from the blackboard as shown by Fig. 5. The desks are usually fairly well covered by books and papers and reflected glare from desk tops may not always be a serious factor. Nevertheless, a direct lighting system must be carefully planned and equipped with suitable fixtures which, when done, will produce excellent lighting. The lighting glassware should have a predominant downward distribution of light.

Fig. 6 shows three of the common forms of direct lighting, enclosing glass unit; Unit A distributes the light sideways and is not suitable for classrooms, B does not produce any advantageous distribution of light and is not as good as C which produces an excellent downward distribution and the most efficient lighting. These are typical forms and not illustrations of exact shapes. It is characteristic of the best form that the diameter is greater than the depth.

Semi-Indirect

Semi-indirect is a type possessing both the merits and the disadvantages

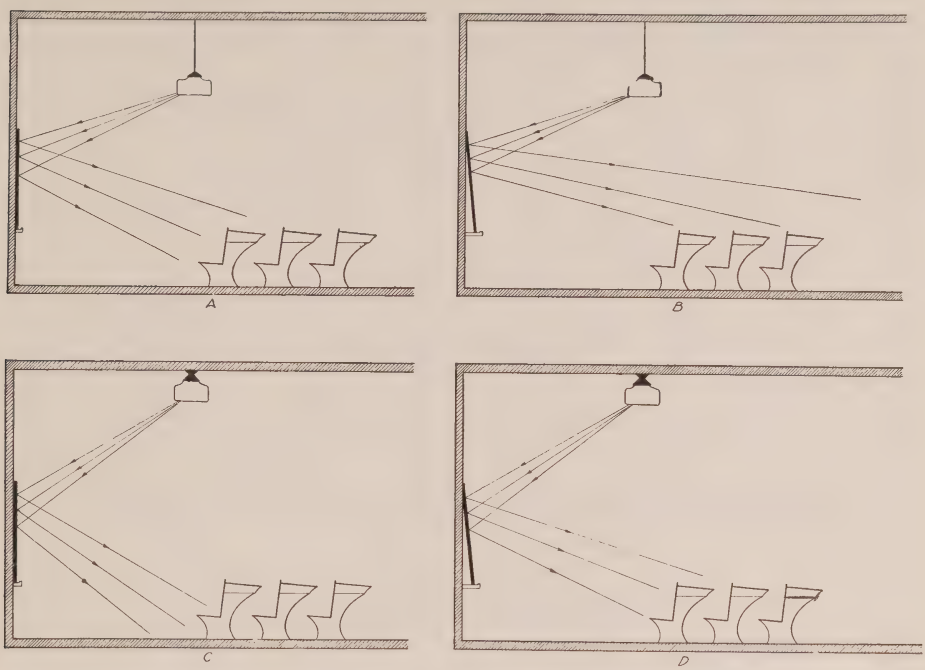
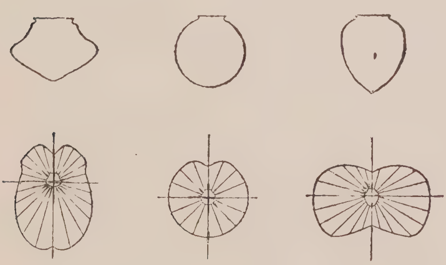


Fig. 5—Showing the advantage of high mounting height of direct lighting fixtures in preventing glare. A and B represent conditions commonly found, too low mounting, causing reflected glare, particularly from sloping blackboard. C and D, with high mounting even sloping blackboard, causes very little glare.

of both of the other types in lesser degree. It projects the greater proportion of the light upward to the ceiling and, consequently, requires high reflecting properties of the ceiling the same as indirect lighting does. It is of two general forms, open bowl and enclosing, the latter is prac-



C B A

Fig. 6—Common forms of direct lighting units. A and B are not suitable for classrooms.

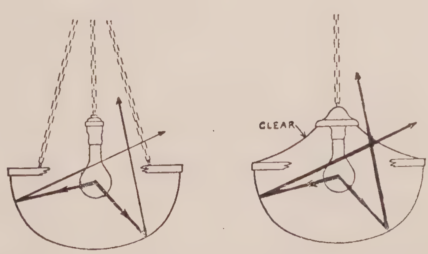


Fig. 7—Light must pass twice through a layer of dust in open bowl reflectors but only once through the dust on enclosing bowl reflectors. Open bowls require more frequent cleaning.

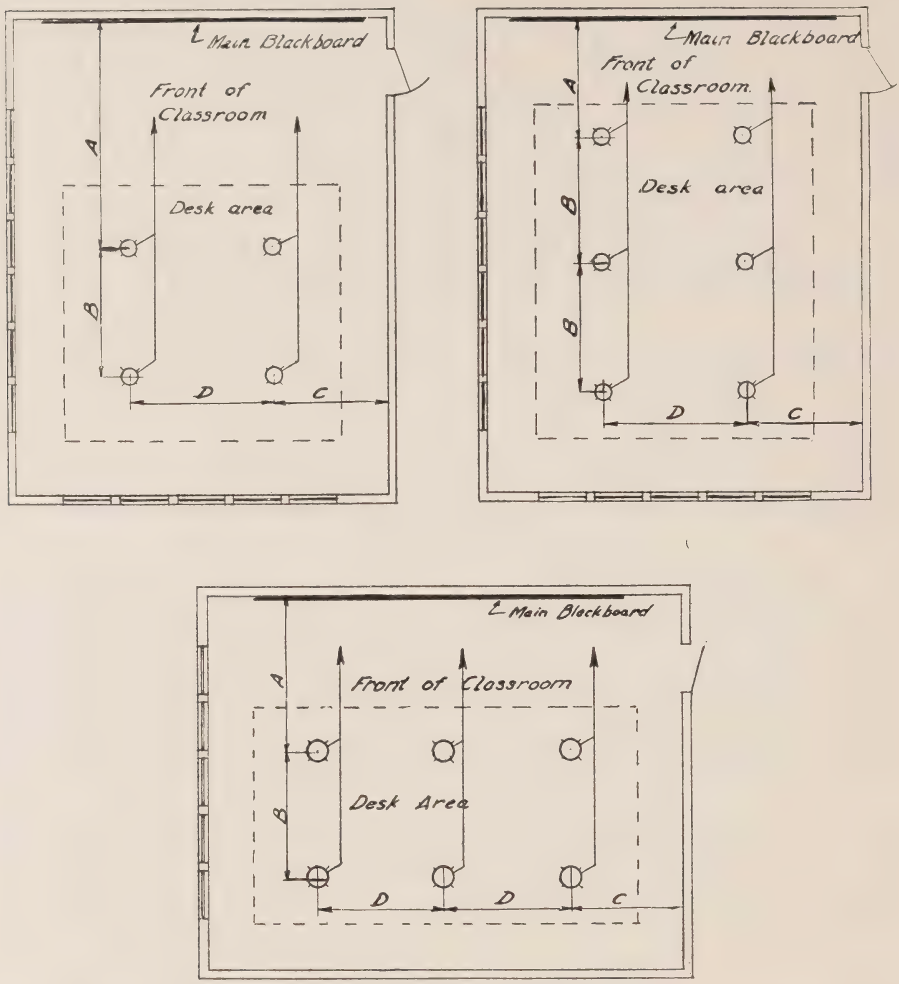


Fig. 8—Showing the arrangements of lighting units to suit the area and the positions of the seating space.

tically dustproof and so more easily cleaned. The open bowls are very close to indirect lighting in the quality of the lighting although the enclosing units are not far removed therefrom. A feature worthy of notice is that with any open bowl reflector the light must pass twice through a layer of dust to emerge while with an enclosing unit it only has to pass through the dust once as shown by Fig. 7. The importance of this depends upon the severity or otherwise of the local dust condition and the frequency of cleaning.

The Number and Arrangements of Units

This is often a perplexing problem which is influenced by the size of the room, the area and position of the

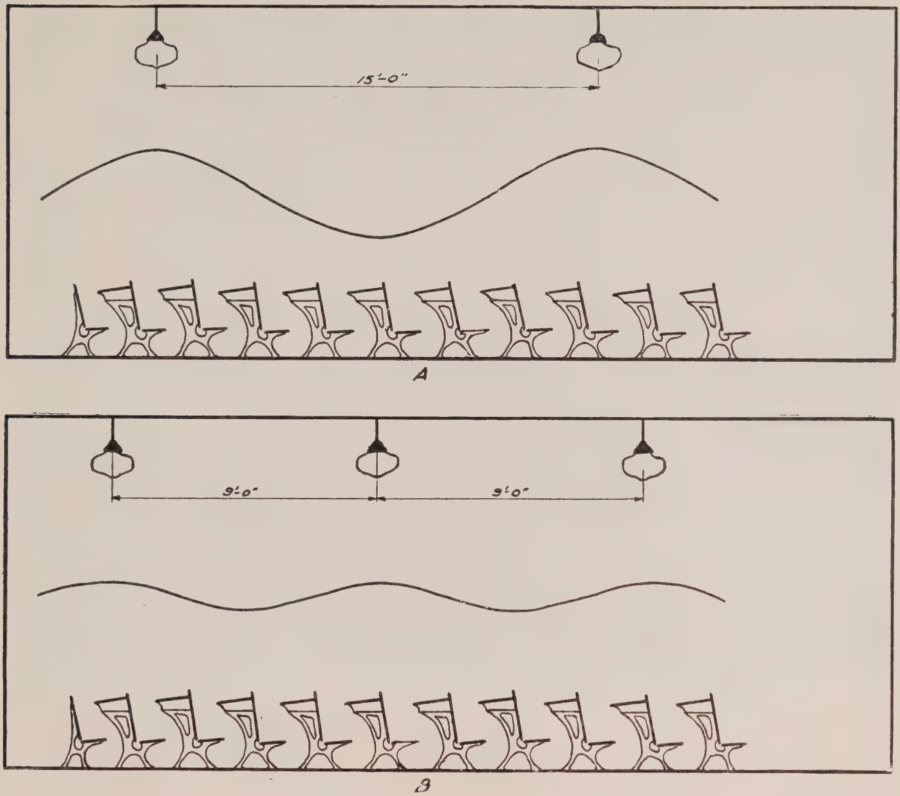


Fig. 9—"A" shows how too great spacing between units causes non-uniform illumination. "B" shows satisfactory spacing and substantially uniform illumination. Note that the fixtures are suspended over the desks and not over unused space.

desk space and the financial condition of the school board. In many rooms there is a lot of unused space between the desks and the blackboard at the front of the room. The general run of school rooms is about 20 ft. by 30 ft. and if all the space is to be used six lighting outlets would be required. We have found, however, that by confining the lighting to the space occupied by desks, many of the rooms can be lighted by four fixtures. We, therefore, place a room in one of three classifications and locate the outlets according to the desk space. This is shown by Fig. 8.

It will be noticed also that the outlets are grouped into circuits so that the fixtures in the dark side of the room can be used independently of those in the side nearest the windows.

If the fixtures are too few in number and the spacing between them is too great there will be a relatively dark area between them as shown on Fig. 9. "A" shows the variation of

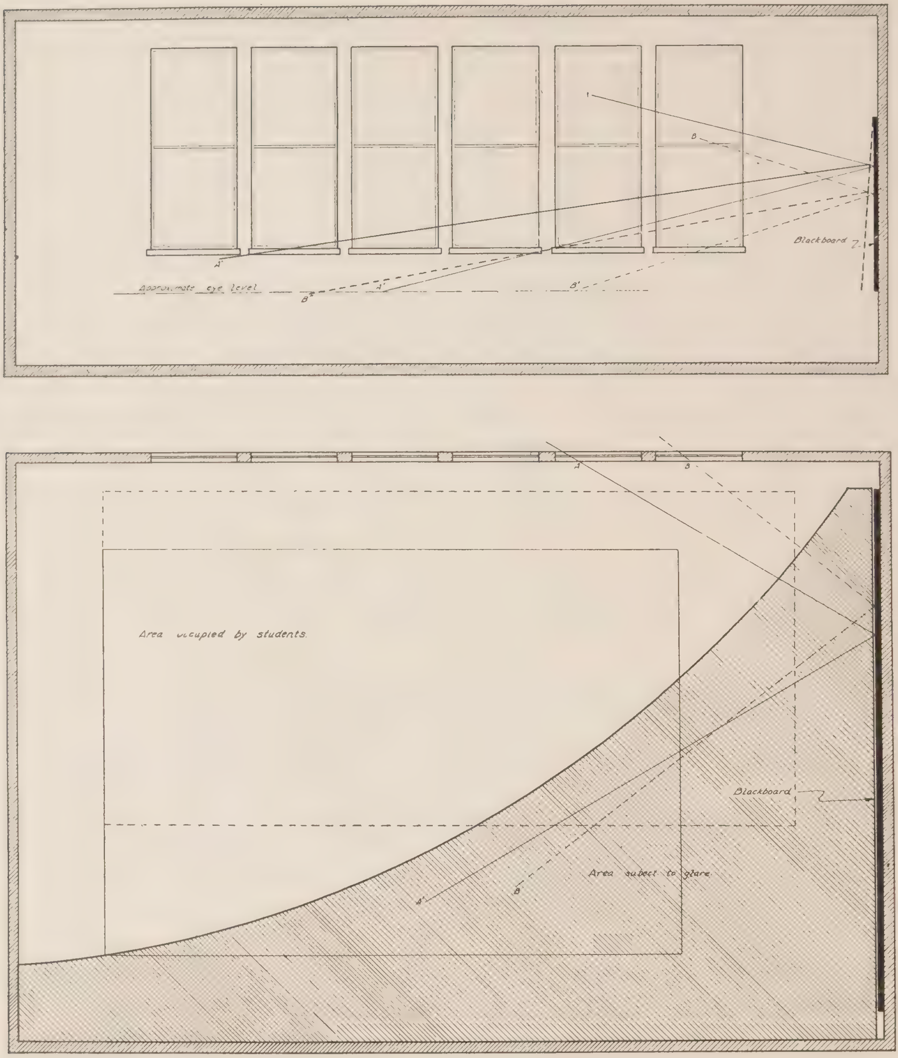


Fig. 10—Shaded area represents the zone within which reflected glare from the blackboard is seen. The upper section is a side illustration that shows how a sloping blackboard accentuates glare by causing the rays of reflected light to be reflected back into the room at higher angles than the vertical blackboard, which results in more of the occupants being bothered by glare than occurs with the vertical blackboard.

illumination from a four fixture (two on each side) installation and "B" from a six fixture (3 on each side) installation. In the former, A, the illumination on the desks below the fixtures is about twice that between the fixtures while in the latter, B, the corresponding ratio is only about 1.2.

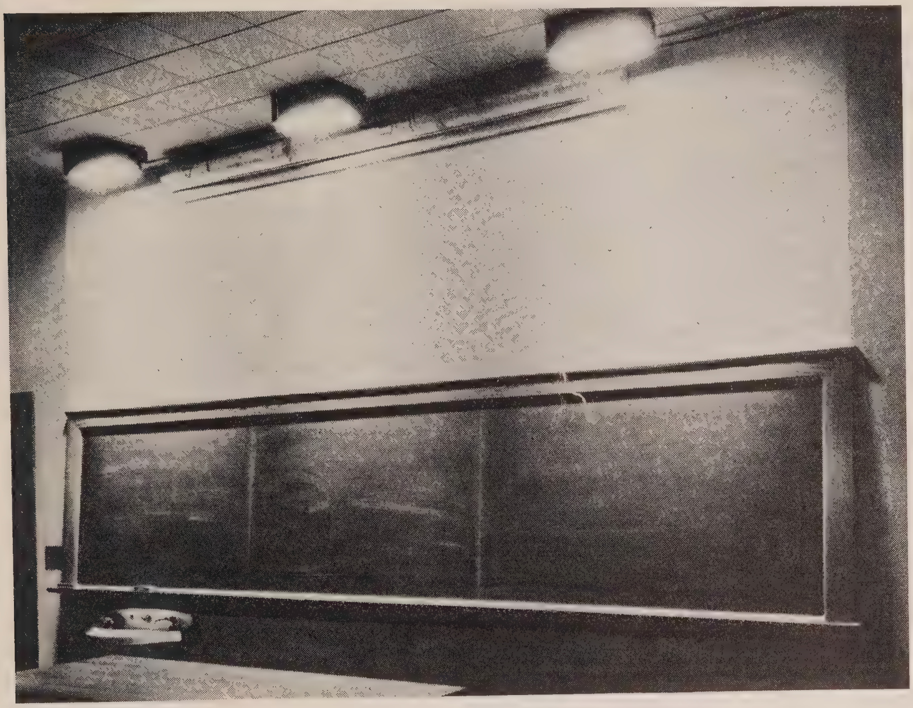


Fig. 11—Prismatic blackboard lighting unit. Each unit requires two 150-watt lamps.

BLACKBOARDS

In every school room lighted by side or rear windows, there is a zone in which there is reflected glare from the blackboards. We have observed a great many cases where it was totally impossible to read what was written thereon. The glare patch on the blackboard is slightly different from every different location in the glare zone and is most severe in the front right section of the room when the windows are on the left side.

Fig. 10 shows the general shape of this glare zone. This glare is caused by the degree of sheen on the board and any treatment that will make the surface dull will decrease the severity of the glare although it is very difficult to eliminate it entirely by treating the surface. The most practical method of preventing the glare is to screen the light from the window nearest to the end of the blackboard and to light the board by units installed especially for this purpose. Figs. 11 and 12 show units that are used for this purpose.

The most efficient window shade is the Venetian blind type. The best material for the ordinary roller shade is what is known as Scotch Holland. This is translucent and softens and diffuses the light without cutting it off completely as the heavily filled materials do.

Fig. 10 shows by dotted lines a suggested change in the location of the

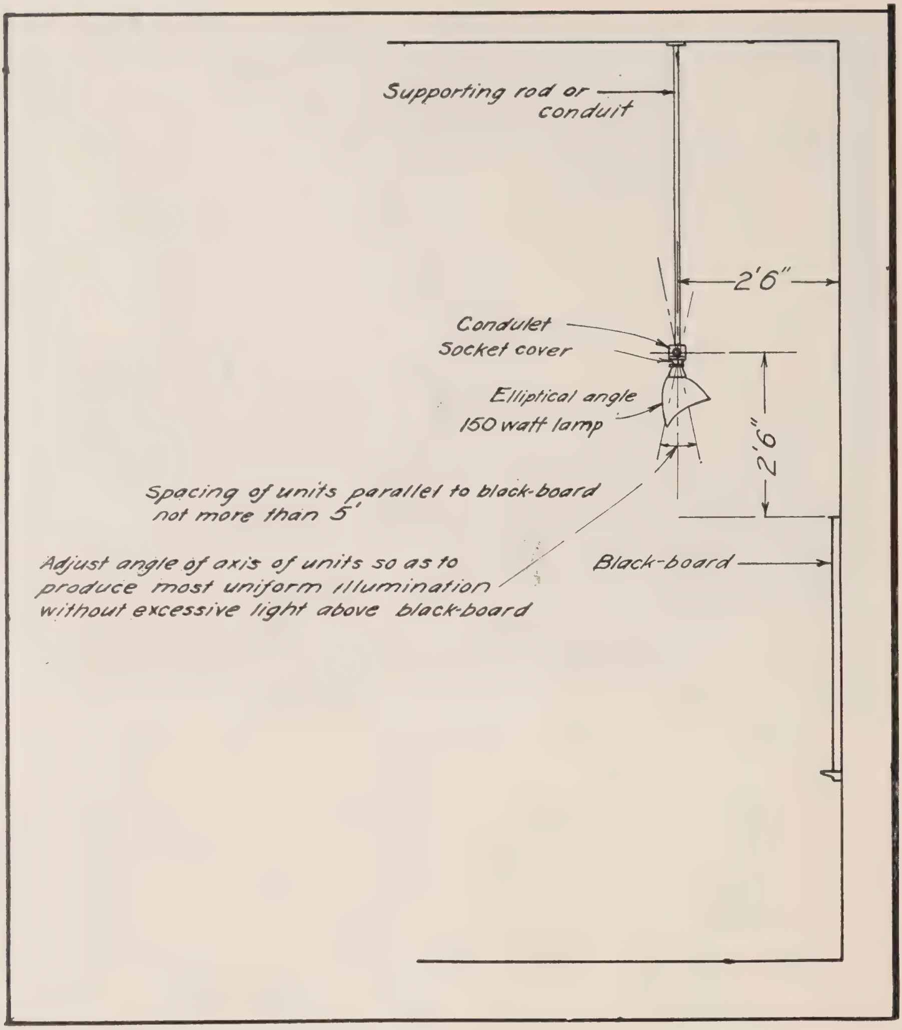


Fig. 12—Elliptical angle porcelain enamelled reflector for blackboard lighting. Each unit requires one 150-watt lamp.

desk space so as to minimize the extent of the glare zone and to place more desks nearer the windows.

Many schools are equipped with blackboards that slope out at the bottom. By the operation of a simple law of optics this slope causes a lot of troublesome glare from both daylight and artificial light that would be avoided with a vertical surface. Fig. 10 shows this condition. By the law of reflection a change in the angle of the reflecting surface of 1° causes a change in the angle of reflected light of 2°. Thus a sloping blackboard reflects light (glare) upward toward the eyes of the pupils, that would otherwise be reflected to the floor causing

no glare. Much blackboard glare would be eliminated by sloping the surface out toward the top. This may be a little less convenient for a tall teacher but it would be a great deal better for the pupils. There is little to commend the present sloping blackboard and much to condemn it.

Desirable Illumination Intensities

There is no exact value for the intensity of lighting required. It has been established beyond question that definite benefits are derived from intensities of over one hundred foot-candles (a foot-candle is the intensity of illumination on a surface 1 ft. from 1 candle). There are minimum values below which the value of the lighting is not consistent with its cost. So, in prescribing lighting we feel that a new installation should be up to the recommended standard of the present day which is 15 foot-candles for ordinary classrooms. Some rooms require much more such as typewriting, drafting, sewing and typesetting. Speed and accuracy are demanded of a stenographer and these accomplishments are very greatly facilitated by good lighting. Drafting involves very fine details and low contrast in a manner that makes good work difficult under poor lighting and in addition sharp shadows must be avoided. Indirect lighting is the best for good drafting. Other branches of manual training call for lighting intensities in accordance with the severity of the visual task.

The selection of the lighting equipment should be made with a view to future requirements. One size of fixture is made for 150 watt and 200 watt lamps and the next size for 300 watt and 500 watt lamps. Where it is possible to utilize the existing wiring for 200 or 250 watt lamps and thereby increase the intensity to 10 foot-candles or so, it will result in a worthwhile improvement. But new wiring will probably have to serve as long as the school exists and it is of doubtful economy to install a subnormal lighting system. The added cost of a system based upon present standards is small compared to the cost of raising the standard later.

The adoption of recommended intensities calls for at least 300 watt lamps in direct lighting and usually 500 watt lamps for semi-indirect or indirect. If 300 watt lamps will fulfill the requirement and the fixture will accommodate 500 watt lamps, is it not logical to provide wiring to also supply 500 watt lamps even though the 300 watt lamps may be installed for the immediate future?

It is being advocated in some quarters to install 500 watt lamps in the fixtures farthest from the windows and 300 watt lamps nearest the windows. This would result in some economy of operation and is feasible in many rooms where day classes only are held.

The current carrying capacity places a definite limit upon future lighting. The decisions of today will effect the eyes and welfare of many future generations of children.

The lighting of rooms for children with subnormal vision requires very high intensities and it is usually more practical to equip the number of rooms necessary for such children and have them all come to these classes specially equipped for them.

AUTOMATIC CONTROL

The decision as to when the lamps should be turned on is a difficult matter as the eye is a very poor measuring instrument and as many of the changes in daylight-intensity take place gradually the eyes have plenty of time to adjust themselves to the decreasing intensity. By the time that one becomes conscious of insufficient light intensity it has reached a value far below that at which artificial light should have been in use. The teacher will probably have been busy with the usual tasks and will not have realized the difficulty under which the pupils have been working. To overcome this situation and to provide for the most effective use of a lighting system control devices actuated by photo-electric cells have been developed that will turn lamps on and off when the daylight goes beyond predetermined intensities. The majority of the rooms require artificial lighting in the dark sides most of the time that classes are in session and it is advocated that these lamps be burned continuously and the other lamps be controlled automatically. One control unit may be connected so as to control the lamps in this way in all of the rooms on the north and east sides of the school.

It was found by one test that over a period of three years the lamps that were automatically controlled were in use nearly three times as much as those that were controlled manually. It is thus evident the teacher cannot be depended upon to give the pupils the full benefit of the lighting system.

This matter is worthy of careful consideration as the purpose of the lighting is to benefit the pupils, the teachers and the school board and the best lighting system benefits no one if it is not used.

ECONOMICS OF SCHOOL LIGHTING

The cost of providing good lighting for schools should not be considered as a direct addition to the total operating cost without full allowance for what it will do.

The total operating cost per pupil per year will probably be of the order of $100.00 and each pupil that fails to pass the examinations represents a definite amount of money to the school board as well as loss to the parents of the pupil and to the pupil.

At the present time an insignificant percentage of the operating cost is spent upon lighting and in many cases the expenditure is practically wasted as the lighting is too low to be of appreciable benefit. Good lighting can be provided for a very small additional cost, two or three percent. being typical.

It has been definitely proven, at least over a three-year test, that good lighting reduces the number of pupils who fail to pass examinations to 1/3 of the number who fail in poorly lighted rooms. It is, therefore, evident that good lighting has a very real economic value and may be expected to at least pay for itself and in a great many cases result in actual economy of operation.

This is cited to show that the money spent on lighting is an asset and not a liability. If one or two pupils pass their examinations because of good lighting who would have failed under inadequate lighting, the money saved

would pay for a lot of the good lighting.

Heating, ventilation and sanitation are well provided for and their value is not underestimated, but lighting is the only item of school equipment that has a definite and direct bearing on the acquirement of knowledge and this has been neglected.

Can anyone suggest an equal expenditure in other lines that would so effectively increase the efficiency of the teachers and facilitate the progress of the pupils?

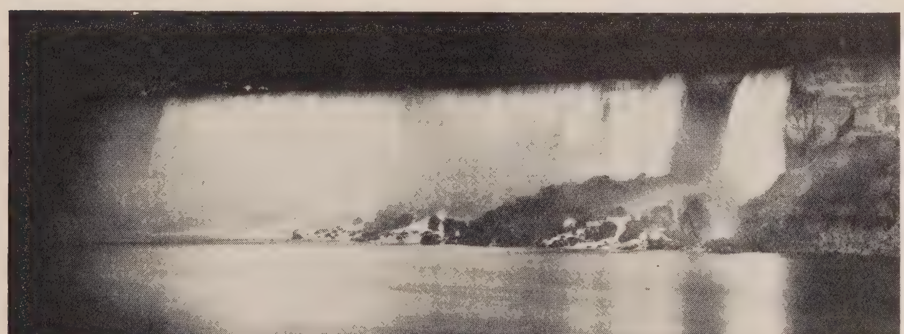
By limiting the expenditure for lighting the cost of adequate lighting is not being saved but the price is being paid in the form of wasted and inefficiently used time, injured eyes and ill health.

Conclusion

During the course of our surveys of lighting conditions in schools observations have been made with a rather critical eye and a great many cases of inefficiency have been observed that were in one way or another related to lighting, both daylight and artificial. We have been led to conclude that, in general, the members of the school-boards are not fully aware of the handicaps caused by inadequate lighting and its serious effect upon the present and the future welfare of the children.

At best the lighting in the dark sides of the rooms is bad and it is made much more so by the injudicious use of window shades. In one school where this was pointed out, we were informed that the shades were drawn down over the upper halves of the windows according to instructions, to improve the appearance from the street.

There are many factors that should be taken into consideration in any attempt to improve seeing conditions in schools, among which are proper locations of outlets, the selection of properly designed lighting equipment, color and condition of the ceiling and upper walls, regular cleaning of the lighting equipment, proper maintenance of the blackboards and intelligent use of window shades and keeping them in good mechanical condition. The factors that are mostly matters of maintenance are often badly neglected. All these details should be taken into account as in the aggregate the combined effects play an important part in the quality of the final result.



Carleton Place P.U.C. Building

IN the year 1912 a Board of Water Commissioners was established to take over the control and management of a system of waterworks and sewerage which was then being built. In June, 1919, a Public Utility Commission was formed because a contract had been made with the Hydro-Electric Power Commission.

From 1912 to 1919, the office work of the Commission was taken care of by the Town Clerk, but with addition of the Electric Department, it was necessary to have space to properly house the Commission's Staff which of necessity was increased. Accordingly, a store was rented on Bridge Street, and this was used until 1924 when it was considered advisable to move into the Town Hall.

It soon became apparent to the Commission that the space in the Town Hall was not suitable and efforts were made to obtain a rearrangement, so that better conditions and more space could be secured. This was not possible, and after looking over many buildings, the Commission eventually selected one which was adjoining the Town Hall on Mill Street.

The lot faced on Mill Street, and extended to a depth of 100 feet to the Mississippi River. On one side is the Town Hall, and on the other, a common right of way, so that on three sides the Commission will have unobstructed light and air.

The building, a solid brick, 32 by 36 ft. with an Ell 16 by 18 ft., was erected about thirty years ago for a lawyer's office and residence, and lent itself to the Commission's requirements with very little change.

The basement is used for shop space and storage for waterworks and electric supplies and equipment, and entrance is had to it from the rear almost at the ground level.

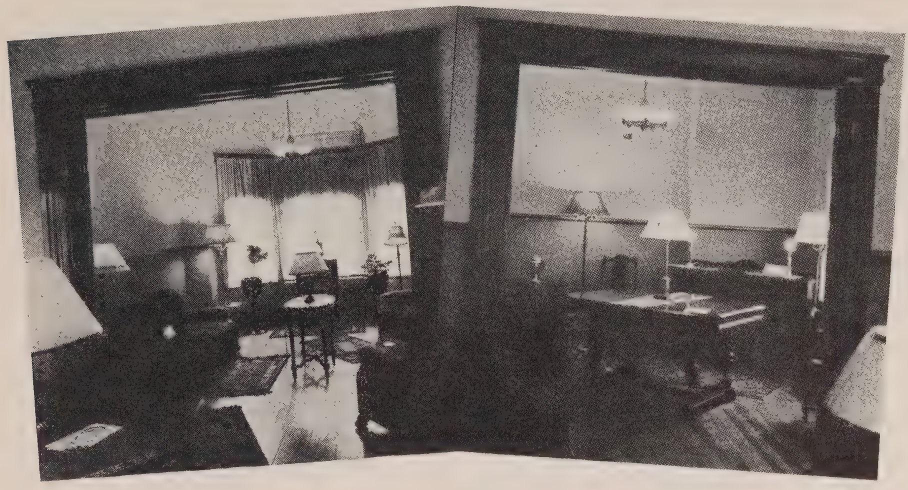
The ground floor is taken up by general office, show room, Manager's office, vault, and a room for the linemen at the rear.

The first floor has a meter room and store room in the rear, a Board room and drafting room in the front. It is proposed to use the Board room for space for a cooking school, or other such use from time to time.

The floors, in the original building, were all hardwood, and were in good shape so that it was but necessary to refinish them. The woodwork was all native white ash finished natural, and in the new work added, this same scheme was carried out.

The walls were finished with a dark buff dado to a height of 4½ feet, paint being used. The balance of the wall was light buff muresco with the ceilings white. The general effect is light and pleasing.

The lighting used throughout the offices and Board room, is a semi-indirect basin suitable for a 300 or 500 watt lamp. The hanger is semi-rigid, and is finished in chrome. With a spacing of approximately 10 feet in the general office, an average of 18 foot candles is secured when using 300 watt lamps.



Better Light Display, Carleton Place Public Utilities.

In wiring the building, all outlets for lighting were wired with No. 12 a.b. cable, and in all cases, the cable was carried to an accessible place in either the attic or basement, so that it could be made as a single circuit. Each fixture was switched separately in order to give flexibility and to prevent unnecessary use of light.

The building is heated by steam from the Town Hall boiler, and the system is so arranged that a boiler could be installed in the basement if it becomes necessary or advisable.

Reference was made to a show room and, since the Commission is not engaged in merchandising, this room is used by the dealers, who appreciate the benefits to be derived from its use. At the time of writing, a demonstration of Better Light, Better Sight, is set up in the form of typical living room, dining room, and kitchen.

The work was carried out by local contractors and the Commission's staff. Efforts were made to divide the work as much as possible among the different tradesmen.

The Commission is to be congratulated on having such good accommodation for its activities. The members for the year 1935, when the work was carried out, were Messrs. Geo. E. Findlay, Chairman; Dr. J. J. McGregor, Mayor; and H. W. Dummert, C. F. Burgess, and Jas. R. Robertson, Commissioners. M. W. Rogers is Manager and Secretary-Treasurer.

W. H. Childs, Hamilton

William H. Childs, General Manager of the Hamilton Hydro-Electric System, died suddenly while driving near Hamilton on the evening of Thursday, April 30th, 1936. Up to and including the day on which he died he appeared to be enjoying health and attended to his business duties as usual. In the evening he started out alone to make a call near Hamilton and was later found dead in his car which he had parked beside the highway.

He was born at Hamilton, the son of William H. Childs, Senior, and the late Mrs. Childs. As a young man he started in business for himself in the manufacture of keys and repairing bicycles.

As a citizen of Hamilton he took an active interest in municipal affairs from the time he was quite young, and his frequent visits to the City Hall resulted in personal acquaintanceship with the city officials year after year.

When the proposal to bring Hydro power to Hamilton was first mooted, Mr. Childs threw in his efforts in support of the cause and did much towards assisting the small band of visionaries in winning the support of the people of Hamilton. In 1910, when Hydro became a reality in Hamilton, he was appointed to the office of Secretary of the local Commission. Here he had much to do with the organisation of the local system, and his constructive ideas, keen business sense and grasp of essentials have contributed much toward making the Hamilton Hydro what it is today. In October, 1933, he was made General

William H. Childs.

Manager, which office he occupied since that time.

His official duties with the Hamilton Hydro brought him into contact with Hydro staffs throughout the whole Province of Ontario, since he was an enthusiastic participant in the activities of the Association of Municipal Electrical Utilities. He was elected a director of that association for the year 1936 and was appointed Chairman of the Committee on Accounting and Office Administration.

Outside his work, Mr. Childs took a keen interest in military affairs and sports. During the Boer War he saw active service with the Hamilton contingent. Again when the 173rd Battalion was mobilised for service in France in 1915 he joined up and accompanied the unit overseas as a Major. On returning he continued his military activities until a couple of years ago.

In sports he was Honorary Treasurer of the Canadian British Empire

Games Committee, and one of the chief workers when the games were staged in Hamilton in 1930. In 1932 he was appointed judge at the finish for the track events at the Los Angeles Olympic Games. He was an ardent worker for the Hamilton Olympic Club and was President of that organisation for a term. For a time he was Vice-President of the Ontario branch of the A.A.U. of Canada, and a member at large of the Dominion body.

Mr. Childs is survived by his widow and two sons, to whom we extend our sympathy in their loss.

J. N. Christie, Ingersoll

On Tuesday, April 28, 1936, death came to James Naismith Christie, who for almost twenty-five years has officiated as Secretary-Treasurer of the Ingersoll Public Utilities Commission. Although he had not been feeling up to the mark for a few days before, he carried on with his duties at the office until the day before his death. His last days were characteristic of his many years of faithful service to the Ingersoll Commission.

Mr. Christie was born in Mitchell, Ont., about 76 years ago. For some years he served there as Town Clerk, having succeeded his father, who had held that position for many years. Later he worked for some years on construction work with a bridge company and after that was employed in the textile and woollen industry. His duties in the office of the Ingersoll Public Utilities Commission brought him into contact with most of the people of the town and his kindly manner of dealing with them caused him to be highly respected by everyone.

Association of Municipal Electrical Utilities

CONVENTION PAPERS AND DISCUSSIONS

The program of papers and discussions for the summer convention of the Association of Municipal Electrical Utilities at Ottawa, on July 2nd and 3rd, 1936, will be as follows:

THURSDAY, JULY 2ND

Paper and Demonstration, "Economic Regulation of Distribution Systems," by A. M. Doyle, Commercial Transformer Engineer and M. J. McHenry, District Manager, Canadian General Electric Company, Toronto.

Paper, "Proper Meter Maintenance," by J. C. Smith, Dominion Gas and Electric Inspector, London.

FRIDAY, JULY 3RD

Paper, "Advertising for the Hydro Utility," by F. C. Adsett, Assistant Engineer, Municipal Engineering Department, H.E.P.C. of Ontario.

Paper and Demonstration, "New Horizons in Lighting," by Samuel G. Hibben, Director of Applied Lighting, Westinghouse Lamp Company, Bloomfield, N.J.

"Symposium of Range Campaign Activities," by representatives from the H.E.P.C. of Ontario, London, Belleville, Sarnia, Toronto, Windsor, Chatham and others.

The convention sessions will be held during the forenoons only, that of Friday, July 3rd, being jointly with the Ontario Municipal Electric Association.

The Rings of Saturn

ALTHOUGH each year finds our sun and moon rising and setting as usual, and all of the stars in their regular places, the planets are continually changing their positions and, to some extent, their movements affect their appearance.

Last summer was rather exceptional. The five planets that may be seen by the unaided eye, were in the evening sky and were very spectacular objects in a telescope. This summer, Venus and Mars will both be missing but Jupiter, with his moons, will be on hand every evening and, late in August, Mercury will be in a favourable position to observe in the western sky.

The most interesting object in the heavens, however, will be the planet Saturn. At the end of June he "loses his rings": they become invisible for a few days in even the very powerful telescopes.

Saturn is the most remote of the planets known to the ancients and, as the telescope later revealed, has the unique and remarkable ring system, no parallel of which is found throughout the universe.

The rings, of which three are recognised, encircle the planet, Fig 1, and revolve about it. The outside diameter of the larger ring is about 171,000 miles, or nearly two and a half times the diameter of the planet, and Saturn itself has a diameter slightly more than nine times that of the earth. The inside diameter of the smaller ring is about 117,000 miles, or sixty per cent. greater than that of the planet.

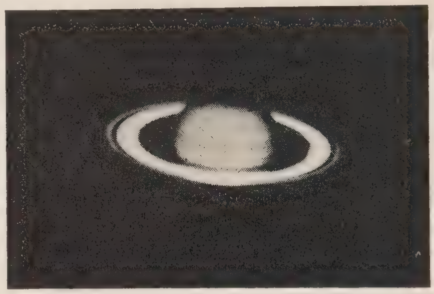


Fig. 1—Saturn, with rings well opened. The shadow of the planet may be seen on the far side of the rings.—Yerkes Observatory.

The rings are extremely thin, their thickness not exceeding ten miles. If a model were made with the outer ring having an outside diameter of seventeen inches, the thickness of the rings then should be less than that of the thinnest tissue paper.

The nature of these rings, upon first thought, may seem somewhat uncertain. However, by observation of their position through even small telescopes and also consideration of gravitational attraction, which exists between all particles of matter throughout the entire universe, a very definite answer is obtained. If the rings were solid, they would be attracted to and held in contact with the planet: as a matter of fact, it has been shown that a solid ring would break up due to mechanical forces. Liquid rings would reflect the sun's light off into space, Fig. 2, and therefore appear dark, possibly be invisible at all times, to observers on the

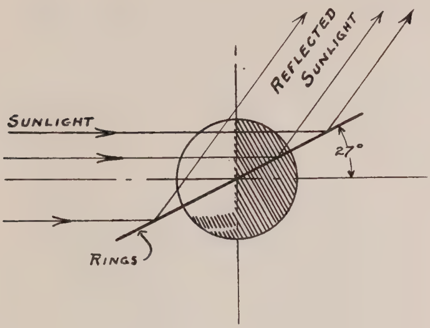


Fig. 2—The rings are inclined about 27 degrees to the plane of the earth's orbit. If they were in liquid state, the sun's light would be reflected off into space, as from a mirror, and the rings would appear very dark, possibly be invisble at all times, to observers on the earth.

earth: such rings would be very unstable, changing their shape due to molecular friction and, in this case also, they would be drawn to the planet's surface. Were the rings gaseous, again they would be unstable and stars or other planets could be seen and followed steadily through all of them.

None of these conditions have been found, however, and the rings evidently are nearly circular, located out at a distance from the planet, which is concentric with them, and are very stable in this position. The conclusion reached, therefore, is that the rings are composed of flocks of small individual bodies,—boulders, moonlets,—which rotate about the planet as centre, held in their various orbits by the attractive force of gravity and reflecting the light of the sun in just the same manner as does our moon.

The ring system is inclined at an angle of about twenty-seven degrees, Fig. 2, to the plane of the earth's orbit, and Saturn requires about thirty years to make one revolution around the sun. There are two points on opposite sides of Saturn's orbit, therefore, and consequently two occasions about fifteen years apart on each revolution, when the rings will appear tipped up to their greatest extent: they are then said to be "fully open" and are slightly wider, in the vertical direction, than the planet itself. This planet, with rings open, is the most strange and spectacular object in the heavens.

Midway between these occasions, however, the rings "close": they are on edge to the earth or, in other words, the earth is in the plane of Saturn's rings. At this time, due to their extreme thinness, the rings cannot be seen.

If the earth be on one side of the plane of the rings and the sun on the other side, the rings are still invisible but their shadow across the planet may easily be seen. The illustration of Fig. 3, being a photo-

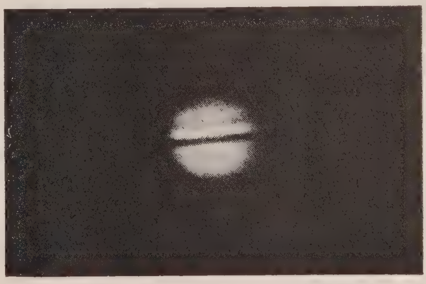


Fig. 3—Saturn, in 1921, with rings invisible. The dark band across the planet is the shadow of the rings.—Lowell Observatory.

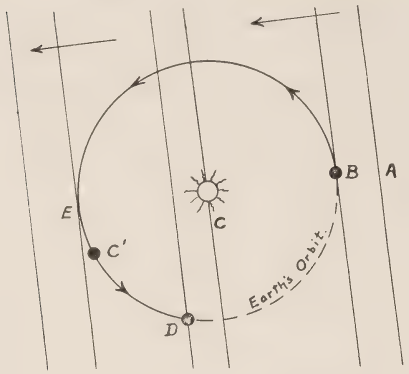


Fig. 4—The relative motion of the earth and the plane of Saturn's rings in 1936-37.

A—May 1, 1936—the plane of the rings has not reached the earth: the rings appear as a very thin straight line.

B—June 28, 29, 1936—the earth just touches the plane: the rings become invisible.

B-C—The rings appear as a thin straight line.

C—December 28, 1936—the plane of the rings crosses the sun, the earth being at C′: the rings again cannot be seen.

C-D—The rings remain invisible but their shadow may be seen.

D—February 20, 1937—the earth meets and definitely crosses the plane: the rings are invisible, also their shadow.

D-E—The rings appear as a thin straight line.

E—About June 30th, 1937—the plane of the rings leaves the earth's orbit: the rings are gradually opening.

graph taken in 1921, shows Saturn under these conditions.

What is happening this year may be followed in the diagram of Fig. 4 which shows the sun, the earth's orbit, and how both will be crossed by the plane of Saturn's rings during the next few months. On May 1st, the plane of the rings, A, moving from right to left in the diagram, had not reached the earth's orbit but will first touch it at B, on June 28th when, by strange coincidence, the earth will be just at this point. The earth merely touches the plane of the rings on this date, and the day following, but does not cross the plane. On these dates, therefore, the rings of Saturn will be invisible: the planet will rise shortly before midnight and should be in a favourable position for observing by about 2.00 a.m.

For several months after this, the earth will move to the left, away from the plane of the rings, and will be at C′, on the opposite side of its orbit, when the plane crosses the sun, C, on December 28th, 1936. As the earth is moving to the right again, next year, it will meet and cross the plane of the rings, at D, on February 20th. On both of these occasions also the rings will not be visible.

From June 29th to December 28th, this year, the rings will appear as a thin straight line. From December 28th to February 20th they will be invisible but their shadow should be seen. After this latter date, the reappearance and gradual opening of the rings may be followed until, about seven years later, the rings will be "fully open". Then, in fifteen years, the present phenomenon will recur.—*F.K.D.*

Hamilton Hydro's New General Manager

Andrew W. Bradt, Chief Engineer of the Hamilton Hydro-Electric System, has been appointed General Manager of the system and Secretary of the Hamilton Hydro-Electric Commission, succeeding the late W. H. Childs. Born in Glanford Township, Wentworth County, Mr. Bradt was educated at the North Glanford public school and the Oregon Institute of Technology in Portland, Ore. He began his electrical career with the Dominion Power and Transmission Company, which company originally supplied Hamilton and district with power from its Decew Falls plant. He left the D.P. and T. in 1908 to accept a position with the Portland Railway, Light and Power Company in Oregon, but returned to Hamilton in 1912 and has since been with the Hamilton Hydro.

Andrew W. Bradt.

Mr. Bradt first worked in the meter department and moved steadily ahead until he had attained the position of Assistant Chief Engineer. Upon the retirement of E. I. Sifton, General Manager and Chief Engineer, in 1933, Mr. Bradt was appointed Chief Engineer. He is a member of the 1936 executive council of the Association of Professional Engineers of Ontario and a member of the American Institute of Electrical Engineers.

O.M.E.A.—A.M.E.U.
CONVENTION

at Ottawa

July 2nd and 3rd, 1936

Utilisation of Developed Water Power in Canada

IN its annual review of the water power resources of Canada, the Dominion Water Power and Hydrometric Bureau, Department of Interior, Bulletin No. 1879, discusses briefly the total figures of available and developed power, current progress in development, the utilisation of the developed power, past and future growth in development, capital invested in water power development and the coal equivalent of developed water power.

The results of the studies outlined in the report, indicate available water power totalling 20,347,400 h.p. under conditions of ordinary minimum flow and 33,617,000 h.p. ordinarily available for six months in the year. The total turbine installation is 7,909,115 h.p.

A favourable distribution of water power resources and of developed power from coast to coast is indicated, and that there is ample water power available within easy transmission distance of practically all of the larger cities. In the districts containing least water power, that is to say, in the southern portions of Alberta and Saskatchewan, there are large fuel resources.

The significance of the distribution of Canadian water power resources is apparent when it is stated that approximately 60 per cent. of the total available water resources and more than 81 per cent. of the developed water power are located in the highly industrialised but coalless provinces of Ontario and Quebec. The advantages of this favourable distribution of water power are being more widely realised as the development of other natural resources throughout Canada is progressively undertaken.

The utilisation of Canada's water power resources is one of the greatest factors in the economical development of many of her other natural resources of field, forest and mine and has also resulted in the importation of considerable quantities of raw materials from foreign countries for manufacture in Canada.

As approximately 88 per cent. of Canada's total hydraulic installation is developed in central electric stations for sale to the public either by the generating organisations or by other organisations concerned only with the distribution of the power it is difficult to trace with accuracy the ultimate use to which the output of the great majority of the hydraulic developments is put. For the purpose of this review the existing installation is divided under the three main headings of central electric stations, pulp and paper mills and other purposes, and it is proposed later to analyse the figures under these three heads.

The installation in central electric stations is the largest and most rapidly growing class and represents the power developed for the sale of electricity to meet the general industrial, commercial, municipal, domestic and

agricultural demands of the public. In all 6,946,241 h.p. or 87.8 per cent. of the total hydraulic installation of Canada is so developed. Pulp and paper mills are shown to have an aggregate hydraulic installation of 605,-346 h.p. or 7.7 per cent. of the total while the installation for other purposes totals 357,528 h.p. or 4.5 per cent. of the total.

The average installation per 1,000 population is shown to be 722 h.p., a total which places Canada in an outstanding position amongst the water power using countries of the world.

As previously stated the provinces of Ontario and Quebec contain more than 81 per cent. of the total developed water power and this represents an installation in Quebec of 1,258 and in Ontario of 712 h.p. per 1,000 of population. British Columbia with a comparatively small population but large power consuming industries, viz.: pulp and paper and mining and which occupies third place in order of total installation ranks second in per capita installation, having 978 h.p. per 1,000 of population. Manitoba, fourth in both population and total installation has an average installation of 532 h.p. per 1,000 of population. The Maritime Provinces have average installations per 1,000 population of 311 in New Brunswick, 221 in Nova Scotia and 27 in Prince Edward Island. Yukon and Northwest Territories with very sparse populations but heavy power demand for the low grade gold mining of the Yukon show an abnormal average of 1,300 h.p. per 1,000 of population, a figure, because of the conditions stated, not comparable with those of the provinces. The provinces of Alberta and Saskatchewan where approximately 50 per cent. of the total electricity produced from fuel is generated have average installations of 92 and 43 h.p. per 1,000 of population.

Water Power in the Central Electric Station Industry

As shown above almost 88 per cent. of Canada's total hydraulic development is installed in central electric stations and this represents more than 95 per cent. of the main plant generating equipment of the industry. This equipment generates more than 98 per cent. of the total electricity produced for sale in Canada and for export.

The low cost of hydro-electricity is indicated by the average revenue per kilowatt-hour generated. After deducting the revenue received from interstation sales, the average revenue per kilowatt-hour received from the actual consumers of hydro-electricity during 1934 was only .549 cent per kilowatt-hour.

The low price and diversity of application of hydro-electricity has resulted in a wonderful stability of demand even during the years when general business suffered severe losses. The output of such stations recorded successive annual increases in each of the years 1922 to 1930. A decline in output which commenced in July, 1930, resulted in a decrease in the 1931 output of less than 10 per cent., followed by a further decline of less than 2 per cent. of the 1931 output in 1932. In May, 1933, a recovery in demand was indicated by the output for that month exceeding that for May, 1932, and each successive month from May, 1933, to January, 1936, the latest for which figures of output have been is-

sued by the Dominion Bureau of Statistics, has shown increased output over the corresponding month of the preceding year. The output for 1935 again created an all time record with an increase of more than 31 per cent. over the previous high figure of 1930.

Water Power in the Pulp and Paper Industry

One of the greatest factors in the growth of demand for hydro-electric power has been the remarkable record of the pulp and paper industry, Canada's predominant manufacturing industry based upon total number of employees, distribution of salaries and wages and power demand and second only to the central electric station industry in total capital invested and value of output.

Canada is in a leading position in the production of newsprint paper which represents 85 per cent. of the total paper output of her mills and has approximately three times the production of that of any other country and approximately one-third of the total world output. The temporary reduction in demand for this product which became evident in 1930 apparently ended in 1933 when a gain in output over 1932 was recorded followed by successive gains in 1934 and in 1935 when a new all time record output was achieved.

As a mechanical power installation of approximately 100 h.p. is required per ton of daily output of newsprint and in addition about an equivalent amount of hydro-electricity is at present being utilised for the production of process steam the power demands of the industry are enormous. More than 95 per cent. of the power used by the industry is hydraulic or hydro-electric.

The industry maintains a hydraulic installation of 605,346 h.p., has a motor installation for operation by hydro-electricity aggregating more than 1,029,000 h.p. or a combined mechanical installation of more than 1,634,000 h.p. In addition the industry purchases 4,782,416,441 kw-hr. from the central electric stations for use in electric boilers. The latter figure combined with the 3,578,006,503 kw-hr. for power and related uses indicates that a total of 8,360,422,944 kw-hr. was purchased during 1934 by the industry from central electric stations. This represents more than 41 per cent. of the total output of hydro-electric central stations during that year.

Water Power in the Mineral Industries

The strategic location of ample resources of hydro power economically adjacent to mineral resources and centres of mining activity and the availability of supplies of this low price power have been dominant factors in the immense and successful development of the mining industry in Canada.

An outstanding feature is the great volume of ore of the lower grades which can be and is profitably mined in consequence of the low cost of power from hydro sources and whose latent wealth is thereby added to the Dominion's active assets.

The latest Annual Report on the Mineral Production of Canada (that for the year 1933) issued by the Do-

minion Bureau of Statistics states that Canada produces, normally, about 90 per cent. of the world's nickel, 60 per cent. of its asbestos, nearly 35 per cent. of its cobalt, 12 per cent. of its gold and lead, 10 per cent. of its silver, 15 per cent. of its zinc and 13 per cent. of its copper and is also one of the world's larger producers of the platinum metals and of aluminium, radium and uranium.

The report shows that during 1933 the industry operated a hydraulic turbine installation of 115,428 h.p. and an electric motor installation driven by purchased power totalling 699,178 h.p. As 98 per cent. of the power sold in Canada is hydro-electricity only a negligible error could be introduced by combining the horsepower of the hydraulic turbines with that of the motors operating by purchased power and stating that 814,606 h.p. or 80 per cent. of the total power installation of 1,016,524 h p. operated by the industry has its origin in the water powers which are found throughout the rugged country in which the major mineral deposits occur.

Based upon value of product, 76.4 per cent. of Canada's total mineral production of 1933 was produced in Ontario, Quebec and British Columbia, and these provinces, where mining is carried on almost entirely with hydro-electricity, used 91.2 per cent. of the total electricity purchased by the industry in that year. This represented 9.8 per cent. of the total central electric station power consumed within the provinces mentioned.

Interesting as are the figures of mineral production and water power utilisation already quoted there is little doubt that the advance of settlement and prospecting over much of Canada's hinterland will uncover mineral deposits of great value, and water power will continue to be a primary factor in their exploitation.

The rocks of the great Laurentian plateau or Pre-Cambrian Shield which occupies 60 per cent. or more of Canada's mainland are remarkable for the variety and extent of their mineral deposits and this area contains more than 57 per cent. of Canada's available water power while a further 17 per cent. occurs in British Columbia and the Yukon and Northwest Territories in both of which mining is most active. So far as information is available there is no present or prospective mineral area, with the exception of some of the coal fields of the middle plains where hydraulic energy cannot be made available as demand arises.

WATER POWER IN OTHER INDUSTRIES

The installations of other than central electric stations and pulp and paper mills, dealing with the use of water power in the mineral industries together with the installations of the electric chemical plants, municipal pumping plants, electric railway plants and the large number of saw, grist and grinding mills and other manufacturing industries throughout Canada, in addition to maintaining the hydraulic installation of 357,528 h.p., provide a broad market for hydro-electricity generated by the central electric stations by purchasing power to operate an electric motor installation of some one and one-half million horsepower.

Past and Future Growth in Water Power Development

The growth of water power development in Canada from 1900 to the present time shows that total water power installation has grown from 173,323 h.p. at the end of 1900 to 7,909,115 h.p. at the end of 1935.

This period also marks the development of the central station industry, as the inception of long distance transmission about the beginning of the present century rendered practicable the development of water power sites remote from the point at which the power was to be utilised. At the end of 1900 the total installation in central electric stations was 62,192 h.p. or only 35.8 per cent. of the total installation, as compared with 6,946,241 h.p. or almost 88 per cent. of the total at the present time.

Capital Invested in Water Power

The investment represented by the present hydraulic installation of 7,909,115 h.p. has been conservatively estimated at $1,890,000,000. This estimate is based largely upon the figures of the Central Electric Station Census for 1934 which includes almost 83 per cent. of the installation.

Coal Equivalent of Developed Water Power

While it is very difficult to assign a precise figure to the coal equivalent of developed water power owing to lack of definite information as to operating conditions in the individual plants, there is no question as to the magnitude of the saving of coal consumption in Canada through the utilisation of water power.

Comparing water power development in Canada with similar development of fuel power elsewhere, a conservative estimate indicates that each installed hydraulic horsepower, if operated continuously throughout the year, would effect a saving of about four and three-quarters tons of coal, or that the present total installation of 7,909,115 h.p. is capable of effecting a saving of thirty-seven and one-half million tons of coal per annum.

The actual saving in any year depends, of course, upon the actual kilowatt-hour output of the plants during the year. Based upon the actual output of central electric stations, it is estimated that the equivalent electrical production of the total water power installation in 1935 was approximately 26,071,000,000 kw-hr. Applying to this a conservative figure of 1.45 lb. of coal per kilowatt-hour (based upon the average consumption of coal and coal equivalent per kilowatt-hour during 1934 by all plants in the United States producing electricity for public use) indicates an actual saving for the year 1935 of 18,901,000 tons of coal.

The foregoing brief review of the water power resources of Canada will serve to indicate their importance to the present and future industrial and domestic life of the Dominion. Large undeveloped powers still remain within easy transmission distance of the principal centres of population, the development of which will ensure adequate power for a considerable time to come.

THE BULLETIN

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Employee Representation Plan

AS a result of suggestions presented to the Commission by Employee Representatives under the Employee Representation Plan, approval has been granted to the following:

(1) One day's rest in seven for all employees of the Commission or the equivalent of this up to four consecutive days off in twenty-eight days; details of such plans to be varied in accordance with the living conditions of employees in various parts of the Province.

(2) All Commission employees paid on an hourly basis who have been permanently and continuously employed for at least two years shall be entitled to two weeks annual vacation with pay.

(3) All Commission employees paid on an hourly basis who have been permanently and continuously employed for at least two years, shall be entitled to statutory holidays with pay, as listed below, or equivalent time off, if it is necessary for the Commission's operations that they work on such specified days: New Year's Day, Good Friday, May 24th, King's Birthday (June 23rd), Dominion Day, Hydro Picnic Day for their District, Civic Holiday for the Municipality in which they reside, Labour Day, Thanksgiving Day and Christmas Day.

Other suggestions are at present receiving the consideration of the Commission and the Management Representatives. It is felt that the hopes for the effective co-operation made possible by the Employee Representation Plan are being fulfilled.

Secretary and Controller
Hydro-Electric Power Commission of Ontario.

JUNE, 1936

The Beginning of Alternating Current

UNDER the title "A Half Century of Engineering Progress", H. W. Cope, Assistant to Vice-President, Westinghouse Electric and Manufacturing Company, traces the progress of the electrical industry and its relation to the company, in the January, 1936, number of *The Electric Journal.* It was in 1886, fifty years ago that George Westinghouse founded the Westinghouse Company after he had become convinced that there was a future for alternating-current systems. The following incidents relating to that time and the subsequent period of development are taken from Mr. Cope's story.

About the year 1882, George Westinghouse became acquainted with Mr. Diomede Pantaleoni, an eminent Italian physician, whose son, Guido Pantaleoni, a student at the University of Turin, came to Pittsburgh to become associated with Mr. Westinghouse. In May, 1885, the son was called back to Italy by the death of his father. While there he was much impressed by an alternating-current system of distribution and cabled his findings to Mr. Westinghouse, who immediately instructed Pantaleoni to secure an option upon the American rights. This was a new system being installed between Cirie and Lanza, by Gaulard, who with a Mr. Gibbs, was inventor of what we now might call the predecessor of the a.c. industry. The patents thus obtained were fundamental, but the ideas and apparatus were crude.

Mr. Westinghouse arranged for a young engineer in his employ, William Stanley, to go to Great Barrington, Massachusetts, to conduct experiments with generators and transformers to prove the feasibility of a commercial power system using alternating current. Stanley, assisted by Reginald Belfield (electrician with Gaulard and Gibbs in London), made rapid progress at Great Barrington, while his associates in Pittsburgh were proceeding with their correlated experiments and designs.

The Gaulard and Gibbs system was series connected constant-current. Stanley substituted transformers connected in parallel to a constant-potential primary circuit. His transformer was wound for 500 volts primary, 100 volts secondary. It was the prototype of all transformers since built and definitely established the commercial feasibility of the alternating-current system. Under date of March 17, 1886, Stanley wrote Mr. Westinghouse:—

"I am pleased to inform you that the secondary system is being rapidly completed. I have . . . run wires from the laboratory to the village and have placed a converter in my cousin's store in order to test the commercial necessities . . . The lamps in the store were running last night . . . I might say a great deal about the system, but briefly, it is all right."

CONTENTS

Vol. XXIII No. 6
JUNE, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

In the early 80's illumination was looked upon as the principal field for the use of electrical energy. Gas was then the chief competitor of the petroleum or "coal oil" lamp. The first controversy was between gas and electricity. The arguments set forth in a paper[1] delivered at that time relative to electrical installations in the City of New York are typical:

"My attention has naturally been attracted by the discussions in the various daily papers of the dangers to life and property believed to come from wires conveying electric currents for the production of lights, which traverse many of our streets . . . It seems to be assumed that if wires were buried under ground the accidents . . . would have been avoided . . . The risk of handling the uninsulated parts of a lamp would be greater . . . The choice is, therefore, not between the present electric lighting and the same with underground wires, but between the present system (overhead wires) and a return to gas . . . The attempt to place all wires underground would result in such an original and continued upturning of streets as would render them impassable, and might cause more injury and loss of life from malaria in a month than the electric wires have occasioned in seven years."

Conditions in manufacturing plants in those days are described by E. S. McClelland, who entered the employ of the Westinghouse Machine Company in 1881:

"Our shops, located at the corner of Twenty-fifth Street and Liberty Avenue, Pittsburgh, were dark and dingy, poorly ventilated, poorly heated, and generally unsanitary. Heating was accomplished through the medium of egg stoves, coal or coke fired, and not too liberally distributed through the shops. In the shop, light was furnished by tallow candles and coal oil lamps; in the offices, the only illumination was provided by kerosene wick-fed lamps with glass chimneys, hot, smelly, and poorly adapted for lighting purposes. The incandescent carbon-filament electric lamp was not yet in use."

E. H. Sniffin, who has been in the company's employ since August, 1886, makes this observation:

"It is amusing to think of the appearance of our officials in those days. Usually they wore silk hats and either

[1]Journal of the Franklin Institute, June, 1912.

a frock coat or cutaway, with striped trousers. Men dressed pretty elaborately in those days, especially if they occupied important positions.

"Of course, things were so much smaller that the head people were in much closer contact with the details of the business. It was not at all unusual to see Mr. H. H. Westinghouse visit a plant and witness the starting of a 60 h.p. engine. It was an important occasion and brought together the customer as well as company principals. The man who started the machine was a person of considerable prominence, usually a middle-aged man who had served as a journeyman machinist; wore whiskers and had plenty of dignity. He was well paid for those days, getting about $125.00 a month."

OPPOSITION TO ALTERNATING CURRENT

In view of the fact that at least 95 per cent. of the electric power generated to-day over the entire country is alternating current, it seems unbelievable that this system could have been attacked so viciously during the early days of its introduction. Direct current was then becoming entrenched in a number of important cities, supported by powerful engineering and financial groups. Engineering reputations as well as what were then considered heavy investments were at stake.

Arguments that to-day appear amusing were then very real. The spearhead of the attack was an effort to create such fear on the part of the public and those making decisions as to the type of system, that they would refuse to have anything to do with alternating current. The following excerpt from an article[3] written by the best-known electrician and inventor of that time illustrates the arguments of the opposition:

"There is no plea which will justify the use of high tension and alternating currents, either in a scientific or a commercial sense. They are employed solely to reduce investment in copper wire and real estate . . . I have always consistently opposed high-tension and alternating systems of electric lighting (although perfectly free to use them) not only on account of danger, but because of their general unreliability and unsuitability for any general system of distribution."

The annual report of a leading manufacturing company for the year 1887 contained this statement:

"The only invention which we do not control is the alternating current, which from the commercial standpoint has no merit in itself, and being of high pressure is notoriously destructive to life and property."

Through press articles, lectures by engineers and scientists, and demonstrations in the electrocution of animals, efforts were made to secure legislation prohibiting the use of alternating current on the grounds that it was dangerous to life and limb. Arguments pro and con sometimes grew bitter. One has only to review the literature of the period to sense the feeling with which the subject was discussed.

The commercial possibilities had been proven at Great Barrington, and in November, 1886, the first com-

[3]North American Review, November, 1889.

mercial alternating-current installation in the United States was put in operation by the Brush Electric Light Company, Buffalo, N.Y. A newspaper[3] thus describes the illumination of a large department store as follows:

"The mammoth dry goods establishment of Adam, Meldrum and Anderson was last evening lighted throughout by the Westinghouse system of incandescent electric lighting, and presented a brilliant appearance . . . The particular advantage of the new system seems to be in the mechanism that has made it possible to utilize a high electric current and by passing it through a converter (transformer) change it to low pressure . . . it is within the range of possibility that a station may be erected at Niagara Falls for the purpose of supplying the whole of western New York with an incandescent system."

Within two years after the starting of the Great Barrington experimental plant approximately 100 alternating-current plants had been installed.

METERS

Without meters a commercial alternating system would be impracticable. It seems proper therefore to refer here to the invention of the induction meter by Shallenberger.

While Lang, one day in 1888, was explaining to Shallenberger some improvements he had made in a new type of alternating-current arc lamp, which was connected in circuit, he dropped a small spring upon the plate surrounding the base of the actuating coil of the lamp. The relation of the coil to the soft-iron laminated core which projects somewhat above the coil was such that what is now known as a shifting field of force was produced by magnetic lines proceeding from the coil and from the core. The coil lodged within this field and began to rotate. Shallenberger quickly analyzed the causes, and within a few months had an ampere-hour meter on the market, and soon thereafter a watthour meter. The same principle was then utilized for indicating instruments for Niagara Falls, the rotation of the disc being restrained by a spring, thereby making the deflection of the disc proportional to the watts. These meters became the prototypes of all house meters of to-day and most modern relays.

THE INDUCTION MOTOR; THE POLYPHASE SYSTEM

The alternating-current system was first conceived as an improved system for lighting. It was single phase. On May 1, 1888, patents were issued to Nikola Tesla, a citizen of Austria-Hungary, covering the polyphase induction motor. They covered these fundamental principles: first, that a magnet moving over a conducting plate or surface exerts a pull on that plate or surface; second, that polyphase alternating currents distributed in a certain definite manner over a magnetic structure produce the same magnetic effect as a mechanically moved magnetic field. All induction motors embody this fundamental principle. Tesla's discoveries probably did more than any other one thing to advance the use of electricity in industry.

Tesla came to Pittsburgh, bringing with him a workable but not a com-

[3]The Buffalo Daily Courier, November 27, 1886.

mercial motor. Within a year or so he and the engineers with whom he was associated had put a number of motors into commercial service, but they required a special generator; the ensemble was still in an experimental stage. Although the records are incomplete, it appears that the first industrial application of a polyphase alternating-current motor in the United States was made in September, 1889, at the First Pool Monongahela Gas Coal Company, at Willock Station, near Pittsburgh. Strangely enough, this was not a simple application such as one would expect. The motor was belted to a Hercules drilling machine with gang-bits located side by side that cut a narrow horizontal slot at the bottom of the vein.

Alternating-Current Power Transmission

Oregon City—The first installation of alternating-current power transmission in the United States was that of the Williamette Falls Electric Company early in 1890. It was Westinghouse equipped, utilized water power at Oregon City, Oregon, and transmitted power for lighting from 100 horsepower, single-phase, 3,000-volt, 133-cycle generators at Oregon City, to Portland, 14 miles away. Here transformers reduced it to 1,000 volts for distribution and again to a lower voltage for lamps.

Telluride—During the winter of 1890 the first commercial high-voltage system in this country for industrial use was installed by Westinghouse in the Telluride, Colorado, mining district, and was put in operation June 19, 1891. This district is one of the richest in ores in the Rocky Mountains but is so rugged and inaccessible that much of the ore could not be moved economically. It was to overcome this handicap that this installation was made. Down in a deep gorge, only three miles from the bankrupt Gold King Mine, was plenty of water power. This was harnessed and the power transmitted to the mine, which was made profitable. Both generator and synchronous motor (started by a small split-phase induction motor) was 100 h.p. 3,000 volts, single-phase, 133 cycles. This was the beginning of a power company that by 1905 comprised six power stations and nearly 1,000 miles of transmission line in Colorado, Utah and Montana. This accomplishment is described in Cassier's Magazine, January, 1905.

"In the light of present achievements in high-tension, long-distance, electric power transmission, the early work of the Telluride Power Company 14 years ago, and further developed in the immediately succeeding years, commands unqualified admiration. It was the work of daring enterprise, pioneer work in the face of discouraging comment from almost everywhere, making its successful outcome all the more gratifying to those who undertook it and interesting to the profession generally."

Two able, courageous brothers, L. L. and P. N. Nunn, made this original installation and developed it into a great power system. Weaker men would have failed. To-day, P. N. Nunn lives happily in his home in San Diego, California, enjoying the fruits of his pioneer days. When he was Chief Engineer of the Telluride Power

Company, he wrote in Cassier's Magazine:

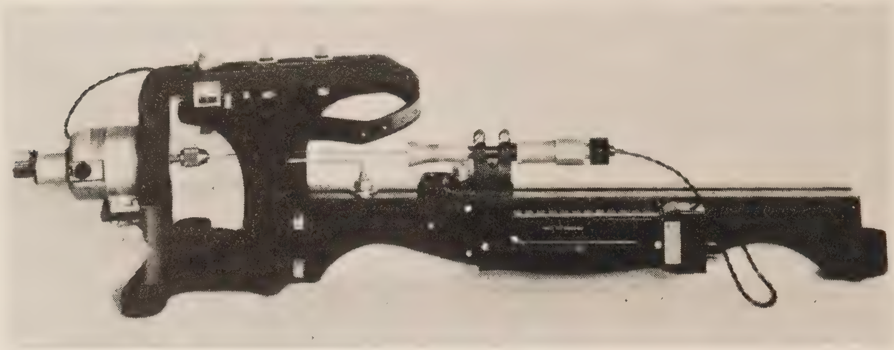
". . . the advantages of alternating current and high pressure became gradually recognized, and a decision was reached to attempt their use. This decision was due less to the immediate saving in copper than to a keen sense of the limitation of continuous current, and faith in the final success and ultimate superiority of alternating current. During the investigation which followed, while selecting apparatus, little but incredulity or ridicule was encountered. Eastern investors in the enterprise were annoyed by the predictions of prominent engineers, and discouraged by their insistence that the experiment would prove a miserable failure and the expenditure go for naught. It was said that there was no alternating-current motor; that oil insulators must be used and that the line must be fenced in . . . Difficulties caused by ice at 40 deg. below zero, by speed control over unusually high water pressure, by avalanche, by blizzard, by electric storms unknown in low altitudes, and scores of other difficulties, now generally forgotten but then most serious, marked every step of progress."

Pomona—The first long distance high-voltage transmission installation in the United States using step-up transformers was that of the San Antonio Lighting & Power Company, Pomona, California, in 1892, also equipped by Westinghouse. There were two 10,000-volt lines, one 14 miles to Pomona and the other 28 miles to San Bernardino. There were two 120 kv-a. single-phase, 1100-volt alternating-current generators. As the transmission voltage was unprecedented and 6 kv-a. was then considered a large transformer capacity, it was decided to use twenty 6 kv-a., 1150/517-volt transformers in series with each generator. A similar arrangement was used at the receiving ends. These were the first oil-filled transformers ever put in service.

THE HARNESSING OF NIAGARA FALLS

For more than a century men of vision had seen behind the grandeur and beauty of Niagara Falls the possibility of utilizing some of its wasted power industrially, but no real progress was made until the Cataract Construction Company was incorporated June 13, 1889. Under the direction of its able president, Edward Dean Adams, it organized the International Niagara Commission, consisting of five eminent scientists of Europe and the United States, with Lord Kelvin as Chairman, "to conduct a scientific symposium on the development of power at Niagara Falls which would attract the best scientific and engineering knowledge and experience of those competent to be found in the nations of the world". After exhaustive studies this commission recommended the electric method utilizing the polyphase alternating-current system.

This was a momentous decision. Its adoption and the successful operation of the Niagara Falls installation established the polyphase alternating-current system throughout the world. It ended further argument for all time.



Haigh-Robertson Fatigue Wire Testing Machine

AMONG the problems encountered in modern engineering practice, one of the most important is the fatigue value of the various metals used on construction.

When material is subjected to repeated reversals of stress of sufficient magnitude, the action is such as to start a microscopic crack which under repeated application spreads till failure occurs. The term fatigue is applied to this behaviour, although a more accurate description would be to say that it is a progressive failure due to repeated alternating stresses. The unit stress which a material can withstand apparently indefinitely, is termed the endurance limit, on which the unit design stress is based.

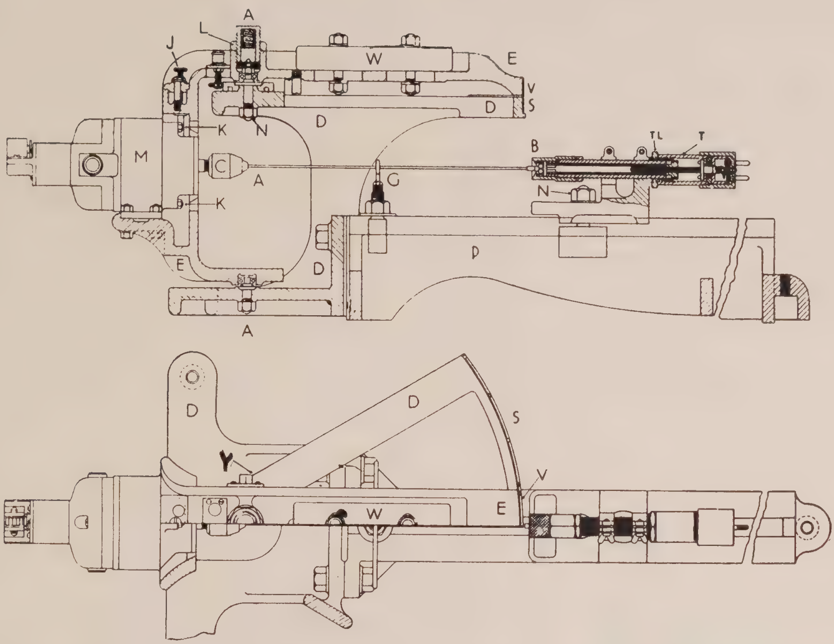
The endurance limit for various materials is considerably below the elastic limit, and is influenced to a great extent by the treatment and processing of the material during the various stages of manufacture.

Examples of fatigue stresses are found in the axles of motor cars, springs, piston rods, electrical conductors and ground cables such as are found in transmission lines.

The first researches made on this important subject were carried out by Wöhler in 1849. The machine used by him was made for heavy sections and was capable of only 100 reversals per minute so that it took a very long time to get any results. As time went on, improvements were made in machines of this kind; but it was not until comparatively recently that a machine was made for the fatigue testing of wire of various kinds.

As the Commission uses large quantities of copper, steel, and aluminum wire in its construction activities, and as a good deal of this wire is subject to reversal of stress, it was decided to obtain a wire fatigue testing machine. The machine chosen was one designed by Professors Haigh and Robertson of the Royal Naval College, Greenwich,

DESCRIPTION OF MACHINE



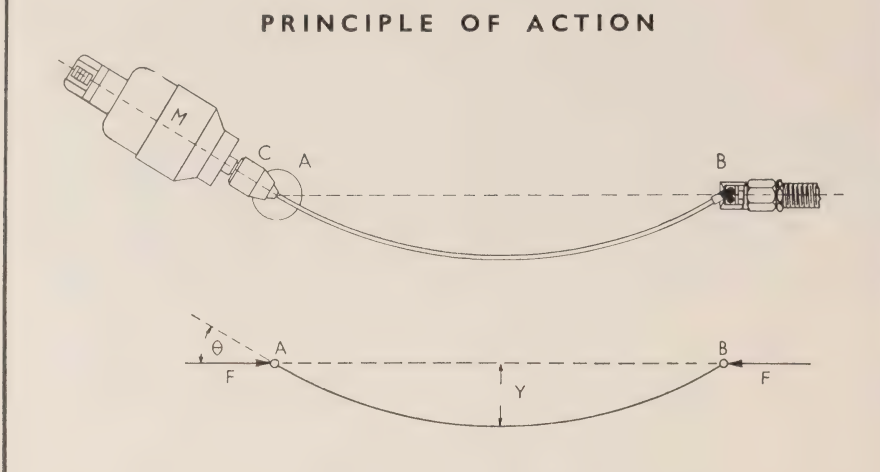
England. This machine will be useful not only in the actual testing of wire but also in giving information which will be of great help in the drafting of specifications for wire.

This machine measures the stress and strain at the seat of fracture in a reliable manner that justifies comparison between different samples. The wire is gripped and loaded in such a way that the accuracy of the tests is not affected. Fractures occur at mid-length in a part away from the grips.

The complete section of wire, both skin and core, is tested in bending under conditions similar to those found in service, and the type of fracture obtained is precisely the same as that which occurs in the field.

PRINCIPLE OF ACTION

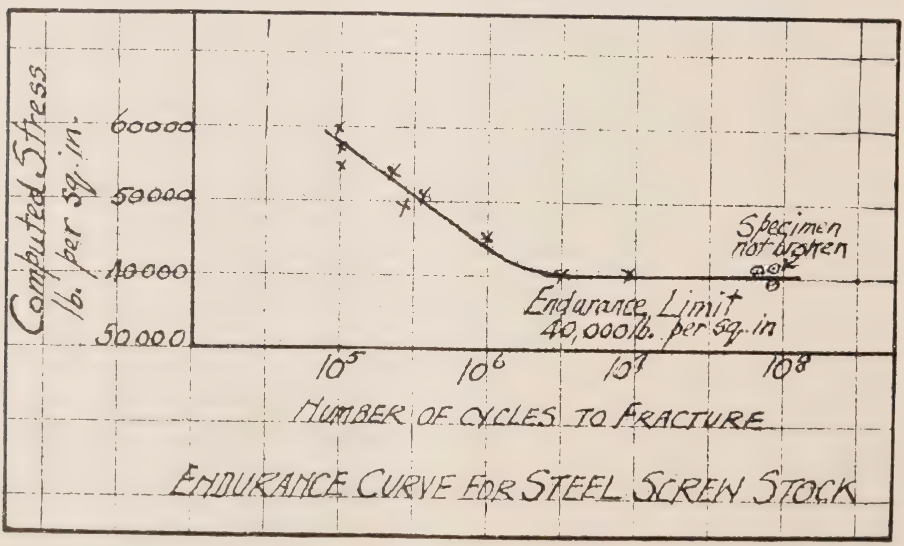
One end of the wire is gripped in a chuck C as in the headstock of a lathe and the other end B is arranged to run on a simple form of thrust bearing that serves as a tailstock. This tailstock bearing is screwed forward to flex the wire as sketched and the chuck C together with the small electric motor M that drives it is arranged to swivel about a vertical axis in bearings A. The use of the ball bearing B and the vertical axis of swivelling A insures that the wire bends in the horizontal plane under the action of two equal and opposite forces F acting along the line AB. The bending moment and curvature of the wire vary along its length and are greatest at midspan where the de-



One end of the wire A is gripped in a chuck C as in the headstock of a lathe, and the other end B is arranged to run on a specially simple form of ball thrust-bearing that serves as a tailstock

flection Y is greatest. Except in this important feature the principle of action corresponds to that of the familiar Wöhler test: the sample of wire is kept rotating until it eventually breaks by fatigue. Fracture occurs at or very near to mid-span and not near the chuck.

It is important to note that the wire does not "whirl" about the straight line joining the points A and B, but rotates about its own curved axis of



flexure like a flexible shaft. The wire rotates so smoothly that it appears at first sight to be at rest in its curve; it is only on closer examination that it is seen to be rotating at very high speed.

The customary speed of operation for wire of ordinary size is about 14,000 rev. per min., but higher speeds up to about 20,000 rev. per min. can be used for wire of smaller gauges.

Description of Machine

The base plate P is arranged as a lathe bed and carries the tailstock B which can be adjusted for testing samples of any length from 3½ to 30 inches. One end of the base plate carries a casting D fitted with the bearings AA that support the swinging headstock E; and this same casting D is fitted with a circular scale S that measures the angle to which the swinging headstock adjusts itself automatically under the action of the thrust transmitter from the tailstock by the flexure of the wire. The swinging headstock which carries the motor chuck and counter is balanced by a weight W and supported by a spring loaded sapphire bearing. The balance arm carries a vernier V indicating the angle on the fixed scale S.

The machine has been assembled and preliminary tests are under way but it will be several months before sufficient data are available for publication.

Short Circuit Kv-a. and Per Cent. Reactance

By H. S. Baker, Meter Engineer, H.E.P.C. of Ont.

"SHORT Circuit kv-a." is an expression intended to measure the severity of short circuits, in regard to any of the following considerations.

1—Ability of a breaker to interrupt the flow.

2—Desirable values for relay settings.

3—Stresses in apparatus.

It is virtually the product of a real amperage and a nominal voltage and should not be visualised as a physical kv-a. quantity.

Its value for three-phase circuits is amperes in one wire times nominal wire-to-wire voltage times 0.001732 .... (1)

If the amperes are not alike in the three wires, then the highest of the three is taken. Thus a 1000 ampere, wire-to-wire short is expressed as the same *Short Circuit kv-a.* value as a 1000 ampere (per wire) three-phase short.

The value of *Short Circuit mv-a.* is one thousandth of the *Short Circuit kv-a.* value for the same short.

The *per cent reactance* of a line section (or other piece of three-phase apparatus) is sometimes expressed as *Based on Rating,* and is sometimes expressed as *Based on 10,000 kv-a. flow at nominal voltage.*

If it is not stated, upon which kv-a. the percentage is based, then it is

often unsafe to assume which kv-a. the writer had in mind when he quoted the percentage reactance of the piece of apparatus.

The value of *per cent reactance* of a piece of three-phase apparatus, (based on 10,000 kv-a.) is:

$$\frac{\text{The Ix drop along one wire} \times 100}{\text{Nominal voltage from wire-to-neutral}}$$

when 10,000 kv-a. balanced load is flowing into the apparatus at nominal line voltage ....(2)

The Ix drop along one wire should not be confused with the arithmetic difference between the voltages from that wire to neutral at its two ends. The Ix drop along one wire is simply the product of the amperes in that wire, with its reactance ohms. The line voltage beyond the apparatus may be less than, or greater than the applied voltage, depending on the power factor of the load and on the ratio of resistance to reactance of the apparatus through which the power flows.

If a piece of three-phase apparatus has, say 1 per cent. reactance based on 10,000 kv-a., then, if 10,000 kv-a. is fed through the apparatus at nominal voltage, the drop along one wire is 1 per cent. of the nominal voltage from one wire to neutral.

If nominal voltage be fed into the apparatus with a dead short beyond, then the drop increases from 1 per cent. to 100 per cent. and the kv-a. fed into the apparatus increases from 10,000 kv-a. to 1,000,000 kv-a.

Had the per cent. reactance (based on 10,000 kv-a.) been 2 per cent., then the short circuit kv-a. would have been 500,000 kv-a.

Hence if full voltage be fed into a piece of apparatus of say x per cent. reactance, based on 10,000 kv-a., with a short beyond, the short circuit kv-a. is:

$$\frac{1{,}000{,}000}{x} \quad \text{........} (3)$$

The short circuit mv-a. is:

$$\frac{1000}{x} \quad \text{........} (3a)$$

If a complex hook-up has an output per cent. reactance at a certain point (based on 10,000 kv-a.), of x, then the short circuit mv-a. at that point is $\frac{1000}{x}$ according to 3a. This is for a short at no load excitation and will be corrected later for shorts under load.

If the per cent. reactance of a piece of three-phase apparatus is quoted as "based on full load kv-a. rating", or "based on rating" and the rating of the apparatus is say P kv-a., then the per cent. reactance based on 10,000 kv-a. is the quoted value times

$$\frac{10{,}000}{P} \quad \text{........} (4)$$

In what follows, all per cent. reactance values will be considered as "based on 10,000 kv-a."

If a three-phase generator (star connected) of xI per cent. instantaneous or inherent reactance, be running at no load and normal voltage and if a three-phase short be applied to its terminals, then it is visualised as a piece of three-phase apparatus of xI per cent. reactance, through which a short circuit is fed from a normal voltage supply.

The instantaneous initial rush of Short Circuit kv-a. is then:

$\frac{1{,}000{,}000}{xI}$ according to 3.

This takes no account of what is called "initial" displacement of current waves which may (on one phase) throw the current wave sufficiently to one side, to nearly double its crest value on the first half cycle.

If this generator had been running on normal load, at normal voltage instead of at no load, then the magnetic flux density in the generator would have been roughly 10 per cent. stronger than for the no load condition, hence a short at the generator terminals would then have an initial value 10 per cent. greater or

$$\frac{1,100,000}{xI} \text{ Short Circuit kv-a.} \quad \ldots\ldots (5)$$

If the above generator has xS per cent. sustained or synchronous reactance and is running at no load and normal voltage, and if a three-phase short is applied to its terminals and the field current held steady, then the sustained value of Short Circuit kv-a. is, according to 3:

$$\frac{1,000,000}{xS}$$

If this generator had been on normal load when the short occurred at its terminals and the field amperes were, say, F times the no load full voltage value and if the field amperes were held steady, then the sustained Short Circuit kv-a. would be:

$$\frac{1,000,000 \ F}{xS} \quad \ldots\ldots (6)$$

It will be noted that the instantaneous value varies directly with the generator magnetic flux before the short, while the sustained value varies directly with the field amperes.

If a generator of xI per cent. instantaneous and xS per cent. sustained reactance feeds through apparatus of xL per cent. reactance into a short under load conditions, then the instantaneous short circuit kv-a. is:

$$\frac{1,100,000}{xI + xL} \quad \ldots\ldots (7)$$

and the sustained value is:

$$\frac{1,000,000 \ F}{xS + xL} \quad \ldots\ldots (8)$$

The value of F may vary between 1.5 and 2.0 or even higher. If vibrating voltage regulators are in service and there are no current limiting devices applied to the regulators, the value of F runs roughly 2.4 on account of the regulator trying to boost the field amperes during long sustained shorts.

If a line section or other stationary piece of three-phase apparatus that is made up of three separate units, has a per cent. reactance of xL per cent., then its per cent. reactance to a wire-to-wire short is:

$$1.155 \ xL \quad \ldots\ldots (9)$$

This is because in the three-phase case, 57.7 per cent. of line voltage applies to one leg reactance ohms, while for a wire-to-wire short the same reactance ohms has 50 per cent. of line voltage applied to it, thus producing less amperes and being equivalent to a higher per cent. reactance.

The matter of single wire-to-ground shorts will not be studied here.

A generator whose per cent. instantaneous three-phase reactance is xI per cent. will have a wire-to-wire instantaneous reactance of 0.87 xI per cent., and a wire-to-neutral instantaneous reactance of 0.66 xI per cent. .... (10)

A generator whose per cent. sustained reactance is xS per cent. will have a wire-to-wire sustained react-

ance of 0.66 xS and a wire-to-neutral sustained reactance of 0.50 xS......(11)

The advantage of expressing short circuit intensities as *Short Circuit kv-a.* instead of as amperes, is illustrated in the following example.

A generator of xI per cent. instantaneous reactance feeds through a set of reactors of xLa per cent. reactance into the 12 kv. side of a bank of transformers of xLb per cent. reactance. The 110 kv. side of the bank feeds through a line section of xLc per cent. reactance into a short. Then, if the generator were on normal load at the time, the instantaneous Short Circuit kv-a. would be:

$$\text{(by 7)}\ \frac{1{,}100{,}000}{xI + xLa + xLb + xLc} \quad \text{....(12)}$$

The value xLc would naturally be quoted as at 110 kv

The value xLb would be the same as referred to either 110 kv. or 12 kv.

The value xLa would naturally be quoted as at 12 kv.

In the above, the transformer ratio does not appear in the calculation.

Had short circuit amperes been used to designate short circuit intensity, then the transformer ratios would have to be figured in.

Note, that for apparatus other than generators or motors, the per cent. reactance is the same value for either instantaneous or sustained shorts and either xI or xS above may be added to xLa etc. Should it be desired to know the ampere value for any given short circuit kv-a. value, then it is obtained from

Amperes per wire =

$$\frac{\text{Short Circuit kv-a.} \times 577}{\text{normal wire-to-wire volts}} \quad \text{............(13)}$$

This is merely equation 1 turned backwards.

Should it be desired to know the percent reactance of a line section or other stationary three-phase apparatus, in terms of the individual reactance ohms per leg, then if x be the reactance ohms per leg and v the nominal wire-to-wire voltage, we have

$$\text{Per cent. reactance} = \frac{x\ 1000}{(\text{kv.})^2} \quad \text{.........(14)}$$

A term similar to per cent. reactance is per cent. resistance based on 10,000 kv.a. flow.

If the ohmic resistance per leg be r, then

$$\text{Per cent. resistance} = \frac{x\ 1000}{(\text{kv.})^2} \quad \text{.........(15)}$$

The value of Short Circuit kv-a. really depends on circuit impedance instead of reactance as assumed above, but in generators and reactors, the ohmic component is only a few per cent. of the reactive component. In power transformers the ohmic component may run to 20 per cent. of the reactive, and in lines it may run to 100 per cent.

In practically all cases, however, when all apparatus is considered, it causes only a small error to neglect the ohmic component, and the error is in the safe direction.

In other words, the calculated Short Circuit kv-a. may be a few per cent. higher when neglecting the ohmic component, than if it were figured in.

In a case where the total circuit ohmic resistance runs as high as 20 per cent. of the reactance ohms, then the impedance ohms are only 2 per cent. more than the reactance ohms.

The Economic Regulation of Distribution Circuits

By A. M. Doyle, Commercial Transformer Engineer and
M. J. McHenry, District Manager, Canadian General
Electric Company, Limited, Toronto

(To be presented to Association of Municipal Electrical Utilities at Ottawa, July 2, 1936.)

THE successful and profitable operation of a Public Utility distribution system depends on the economic consideration of two fundamentals. The record of the Public Utility systems of Ontario, in respect to continuity of service, is so high that it is evident that the importance of one of these fundamentals is fully realized. However, the other fundamental is of equal importance, and it is believed that the benefits to be gained from close voltage regulation, at the consumers' premises, are not fully appreciated by all operating engineers and executives.

The success, so far achieved, of the "Better Light—Better Sight" movement, assures its continued growth. The purpose of this movement is to make the consumers "light conscious". To do this they are being introduced to light meters to measure intensities of illumination. They are being told that they should have 25 foot-candles on their reading surfaces and they are purchasing fixtures and luminaires designed to give them that degree of illumination.

However, by acquainting the users with "Better Light—Better Sight", their curiosity has been aroused, so that it is becoming relatively common for them to obtain light meters to check up on the light they are obtaining, and strange to relate, they are not always getting 25 foot-candles, but only 20, or even 15. They have followed basic recommendations in purchasing fixtures with the proper size of lamps, but are not getting the light they were told they should have. Why is this? Chiefly because the voltage delivered to their fixtures is lower than that for which the lamps were designed. Since the light output of a standard lamp varies somewhat more than three per cent. for each one per cent. variation in voltage, a voltage only six per cent. below normal will result in the lamp giving only 20 foot-candles instead of 25. Also the power consumption will be decreased about ten per cent., so that the utility is faced with loss of revenue as well as dissatisfied customers.

On the other hand, if the voltage is high the life of the lamp will be shortened. The average life of a 115-volt lamp, operated at 120 volts, will be reduced almost 40 per cent. Thus when the original 100-watt lamp sold with the modern lighting fixture burns out before the end of its expected life, the customer has some feeling of resentment. Also it is well known that most consumers are inclined to use smaller lamps than are recommended, so it is more than likely that the 100-watt lamp will be re-

placed by a cheaper 60-watt lamp—thus again reducing revenue.

However, load building activities are not being confined to the field of lighting. Electric ranges, water heaters, and refrigerators are being actively promoted by the utilities and the manufacturers. Each new device connected to the utility lines means added load to cause additional voltage drop. Of even more importance, however, is the fact that each sale is based on certain claims of performance. If these claims are proved correct the user is satisfied, but only too often he will complain of unsatisfactory performance which can usually be traced to low voltage.

For example, it may take 20 minutes to cook a steak. In a resistance element, power consumption varies as the square of voltage. Thus, if the voltage is 10 per cent. below normal, only 81 per cent. of the normal heat will be generated, and it will take 25 minutes to cook the steak. This may not seem to be a matter of great importance, but speed of operation has long been the foremost argument of electric cooking's chief competitor, and five minutes may represent the difference between an enthusiastic booster for electric cooking and a disgruntled, dissatisfied consumer.

Likewise with flat-rate water heaters, a customer may decide, because that's all his friend needs, that a 500-watt heater will give him an adequate supply of hot water. If his voltage is 10 per cent. low, he's only getting 400 watts of heat and not enough hot water, so he has a grievance which does not improve consumer relations. If the voltage is 10 per cent. high, the utility is supplying him 600 watts, but is only being paid for 500, and is thus losing 40 cents per month in revenue.

Likewise in industry, the electrical manufacturers, in co-operation with the utilities, are doing all they can to promote industrial heating applications. This is a relatively new development which will continue to grow, so long as satisfactory operation is obtained. This satisfactory operation depends to a large extent on close voltage regulation on the equipment.

Electric motors are most efficient and maintain their desirable characteristics of speed regulation, starting torque, etc., so long as voltage variations are small.

To sum up—the satisfactory operation of all power-consuming devices depends on maintaining voltage within narrow limits at their terminals. If this is not done, the utility suffers in three ways:

First—Dissatisfied Customers—Equipment does not operate as the customer has a right to expect it. Lamp replacement costs are excessive, operating times of heating devices are not satisfactory, etc.

Second—Slow Load Growth—Consumers will not install ranges, water heaters, industrial furnaces, etc., because due to low voltage, they are too slow in operation compared with competitive fuels.

Third—Loss of Revenue—Each one per cent. drop below normal voltage results in a one and one-half per cent. loss in revenue, and the maximum voltage drop occurs during the peak-load period when the greatest proportion of revenue is produced.

Distribution Problems and Their Solution

Distribution circuits present a large number of problems which may be disposed of by the "hit-and-miss" method, or economically solved by a thorough engineering study. These problems are due to the difficulty of accurately forecasting load growth on individual circuits and the necessity of balancing the cost of the initial installation with a small load, against the ultimate cost with a completely built-up area of high load density.

For a small initial load with prospects of relatively slow load growth, economics will allow only the smallest possible capital investment. However, load growth may be rapid, necessitating quick action to relieve overloaded transformers and to improve voltage regulation. In the past, in too many cases, the least burdensome method has been followed. Each utility standarized on a certain size of conductor for its distribution circuits, fixed a standard size of transformers and assumed a standard spacing for a given load area. If customers complained of poor voltage, or if a transformer was seriously overloaded, the transformer was replaced by a larger unit; a supplementary unit was installed; or else if the condition was sufficiently serious, larger copper was substituted at very great expense.

Until the depression started, engineering thought was so busily engaged on generation and transmission problems that the distribution system was, to a considerable extent, neglected, even though the investment in the distribution system was quite comparable to that of the transmission and generating system. The continued domestic load growth throughout the depression, and the fact that few new generating stations have been projected, has resulted in engineering attention being focused on the distribution system. This means that today, new methods, new arrangements and new equipments are available to assist in the economical solution of the problems faced by the distribution engineer.

New Circuit Arrangements

Let us briefly investigate some of these new developments, realizing that from the point of view of regulation, we are primarily interested in the voltage at the customer's premises, and thus must consider not only the drop in the distribution circuit, but also that in the 115/230-volt secondary. Studies have been made which indicate that the most economical method of supplying residential load is to use small distribution transformers, spaced close together, with small-size secondary copper. With larger transformers spaced further apart, the size of the secondary must be increased as the square of the spacing to give the same voltage regulation.

This conception is contrary to the ideas of a great many engineers, probably due to the lower cost per kv-a. of larger transformers. However, it has been found, that for a given load density the saving due to the larger transformers is more than offset by the increased cost of the secondary for the same voltage drop.

A study has recently been completed which was based on assumed conditions of load factor, cost of

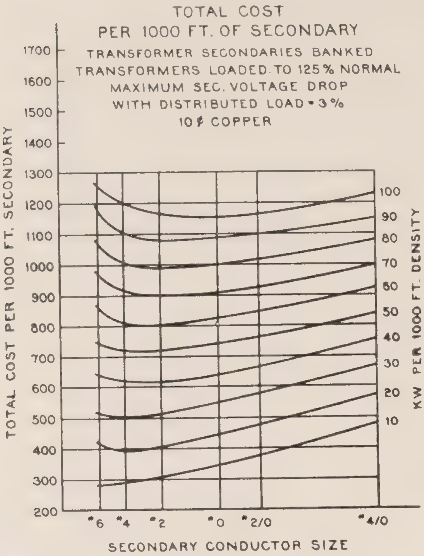


Fig. 1

losses, construction costs and engineering practice. The results of this study, indicating the cost of the various sizes of secondaries are summarized below. The close agreement between the calculated values and those found on some actual systems indicate that the assumptions made were reasonably correct. However, the curves should not be indiscriminately applied to any particular system without checking local conditions.

Fig. 1 illustrates the total costs per 1,000 feet of secondary on a 60-cycle circuit with distributed load and a permissible secondary voltage drop of 3 per cent. for various load densities. As can be seen, for any load density less than 100 kw. per 1,000 feet, the most economical size of secondary will be either No. 2, No. 4, or smaller.

Fig. 2 indicates the maximum length of secondary to permit 3 per cent. voltage drop.

As an example consider a load of 100 kw. uniformly distributed over a feeder 3,300 feet long. This gives a density of 30 kw. per 1,000 feet. From Fig. 1, No. 4 secondary is the most economical. From Fig. 2, the maximum permissible distance from the transformer is 335 feet. Assuming the transformer secondaries are banked with a continuous run of secondary conductor, this means that the distance between transformers will be 670 feet. If a 25 per cent. overload is permitted on the transformer during the peak-load period, the most economical size will be $\frac{30}{1.25} \times \frac{670}{1,000}$ or 16 kv-a. Obviously for standardization reasons, 15-kv-a. units would be chosen at a spacing of approximately 625 feet.

It should be noted that these curves have been established on a base cop-

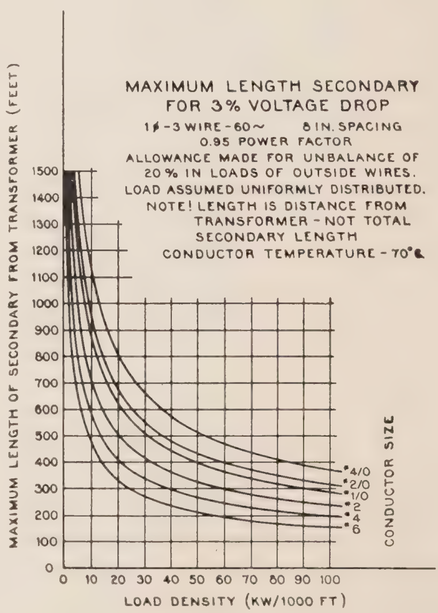


Fig. 2

per cost of 10 cents per pound. As the price of copper advances, the economies of the small transformer will be even more attractive.

BANKED SECONDARIES

As can be seen above, a continuous run of secondary copper with transformers paralleled on both high-voltage and low-voltage sides, plays an important part in reducing the size of secondary for the same voltage drop. The banked secondary system will provide a greater degree of service continuity since a damaged transformer will not interrupt the customer's supply. Also, smaller transformers can be used by considering diversity in loading between individual customers. With the more widespread use of electric refrigerators, voltage dip due to motor-starting currents is becoming a real problem. Banked secondaries, by providing parallel paths to the customer will greatly reduce this flicker.

The practice of banking secondaries has become quite widespread in some localities, even though some difficulty was experienced in segregating damaged transformers. This difficulty has been eliminated by the development of a small secondary cutout, which prevents feed-back into a damaged transformer from the secondary. The practice of banking with continuous secondaries simplifies the problem of load growth, since additional units can be easily cut into the system at a lower cost than replacement with larger units.

Some utilities are not only using banked secondaries by themselves, but are also forming small network grids, by furnishing power from a number of feeders, thus reducing the possibility of outages.

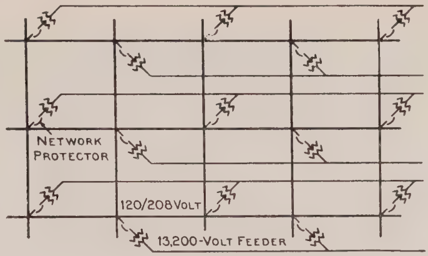


Fig. 3

LOW-VOLTAGE NETWORKS

The low-voltage network is being widely applied to important load areas of relatively heavy load density where continuity of service and good voltage regulation are particularly important. Such areas include the business areas, small manufacturing sections, and apartment house districts of the larger cities. The network system of distribution is generally started to supplement and supersede the d.c. network, which in the past was used for important loads, due to its permissible emergency operation on storage batteries. The a.c. network consists of a number of subtransmission feeders at 13,200 volts or higher feeding, through transformers, a 120/208Y-volt, 3-phase network. All the secondaries are continuous runs. Several feeders are used to insure continuity of service. A system of this kind is usually underground, so the transformers with associated equipment, are contained in vaults under sidewalks, or in the basements of large buildings.

Fig. 3 shows the elements of a low-voltage network in which the light lines indicate a number of 13,200-volt feeders, connected through transformers to the 208-volt grid. The

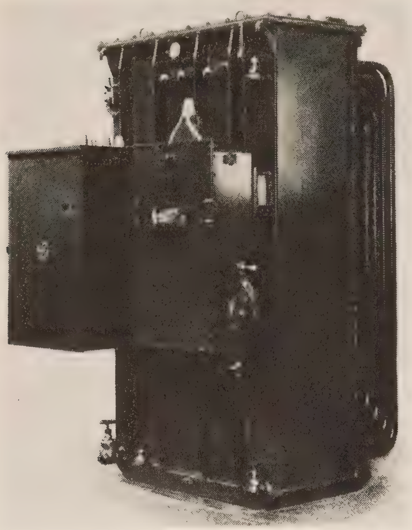


Fig. 4

essential equipment consists of a transformer, usually 300 to 500 kv-a., three-phase, a high-voltage, oil-immersed, disconnecting switch, and a low-voltage network protector as illustrated in Fig. 4. The purpose of the network protector is to automatically disconnect the transformer from the network in case of trouble in the transformer or the high-voltage supply lines. The high-voltage disconnecting switch serves to isolate the transformer from the power supply during routine inspection, and maintenance work in the transformer vault. The network system of distribution, for areas of heavy load density is desirable from the following view-points:

1. The reliability is as good as that of the d.c. network with considerably reduced cost.

2. All the low-voltage lines are fed at a number of points, so voltage regulation is much improved.

3. Power is fed most of the way to the load at high voltage, so the voltage drop is reduced.

4. Units may be added where and when required, eliminating guesswork in load growth forecasts.

5. 13,200-4,000-volt substations are eliminated, thus reducing overall costs.

6. Duct space requirements are reduced by supplying power at higher voltages.

The low-voltage network system offers definite economies, in areas of reasonably high load densities where the probable load growth will be rapid. The initial cost is generally somewhat higher than that of a radial system, but as the network area extends, it will generally prove itself more economical. In addition it has a record of voltage regulation and continuity of service which the radial system cannot approach.

It is not necessary to perform a major operation to start a network—any small area, or new large building may be used as the nucleus. For loads of sufficient importance to justify two sources of power supply, the usual arrangement has been to have an emergency throw-over from one source to the other. Two network units, one on each source will give the necessary reliability and will form the backbone of the network. After a number of such "spot" networks have been installed, it is a relatively simple matter to connect them together.

Network areas of considerable magnitude are in operation in both Toronto and London. Undoubtedly, as load growth continues these areas will be extended.

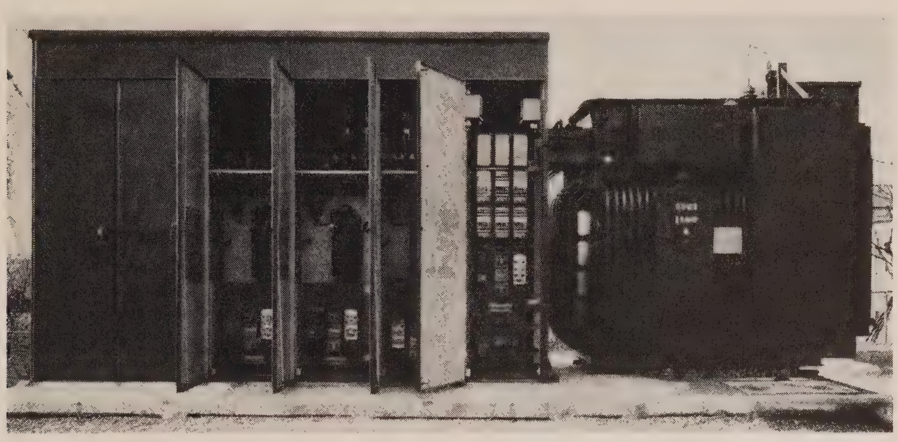


Fig. 5

The Unit Substation

Paralleling the economical solution of the problem of 115/230-volt supply by using smaller transformers, more closely spaced, with smaller size copper, there is a decided tendency to reduce the size of the substations feeding residential areas. With the smaller substation, the size and length of the 4,000-volt feeder is materially reduced; voltage regulation is greatly improved; the area affected by a substation outage is reduced; and the necessity for long-range planning is eliminated since the substation can be installed at the time and place of load growth.

Realizing the economies to be effected, and anticipating the trend towards the smaller substation, the "Unit Substation" has been developed.

Fig. 5 illustrates a typical unit, which consists of a three-phase, 1,500/2,000-kv-a. transformer, with automatic tap-changing equipment for voltage regulation; five metal-clad circuit breaker sections (one transformer and four feeder breakers); and metering and control compartments.

The transformer steps down the supply voltage of 13,200, or higher, to 4,000 volts. It has a self-cooled rating of 1,500 kv-a., but is provided with air blast equipment to give an emergency rating of 2,000 kv-a. It is provided with an oil-immersed high-voltage disconnecting switch, and high-voltage pothead to receive the incoming cable. Automatic load-ratio control operated by a contact-making voltmeter, maintains close voltage regulation over the 4,000-volt system.

The switchgear equipment is contained in a weatherproof steel structure which bolts directly to the side of the transformer. There is a separate section for each oil circuit breaker, which contains the breaker itself, its operating mechanism, disconnecting switches to isolate the breaker, and the relaying equipment associated with the circuit of the breaker. Another section is ar-

ranged to include the metering instruments for the entire station, such relaying equipment as is not directly associated with any one breaker, the automatic control equipment for the load-ratio control, and the equipment required for providing control power at the station.

In addition to the benefits accruing through using smaller substations, the Unit Substations offer these advantages:

1. Real estate costs are reduced. The small unit equipment permits installation in a small space.

2. It can be moved as load conditions require.

3. Its complete metal-clad assembly contributes to safety.

4. Excellent voltage regulation is assured by the automatic tapchanger.

5. The complete unit is factory assembled. It is only necessary to supply a concrete foundation and connect up high-voltage and low-voltage conductors.

THE 4,000-VOLT NETWORK

With the installation of a number of Unit Substations, it will probably prove desirable to interconnect their secondaries to form a 4,000-volt network. Such a network would be fed from a number of 13,200-volt feeders, and would serve, as does the low-voltage network, to reduce the possibility of service interruptions. By feeding the 4,000-volt system at a number of points, it is possible to maintain voltage within much narrower limits than could be done with the radial system.

The economic application of these circuit arrangements can be summarized as follows:

1. Small transformers, closely spaced, with small secondary copper are economically sound for all built-up urban and suburban areas.

2. Banked secondaries offer a higher level of service for most domestic loadings.

3. Low-voltage networks should be considered for all urban loads of relatively high load density where load growth may be rapid and where the highest class of service is important.

4. Unit Substations should be considered whenever any new substation is necessary to supplement or relieve existing stations.

5. The 4,000-volt network is suggested to improve voltage regulation and ensure a higher degree of service security in urban residential areas.

REGULATING EQUIPMENTS

The discussion presented above has outlined some of the modern conceptions of distribution practice, most of which involve new load growth in urban areas. However, there are many circuits, urban, suburban, and rural, on which the voltage variation is too great, and which do not justify a change-over in distribution methods. For regulation on the 115/230-volt secondaries, the possibilities of small transformers, closely spaced, with small secondaries, and banked transformers, must be kept in mind. For regulation of the supply circuit—from 2,300 to 13,800 volts—there are a number of economical equipments available, which will deliver a proper

voltage to the domestic services, assure the satisfactory operation of the consumers' equipment, and at the same time provide a very good return on the capital investment. The use of one, or more, of these equipments will enable the utility to maintain voltage at the feeder load centre, during the peak load period, when the largest proportion of revenue is produced. Calculations, substantiated by tests on actual distribution circuits, indicate that, on the basis of a 30 per cent. load factor, the total power consumption is increased 2.35 per cent. by maintaining voltage during the heavy load period. This means that, while the regulating devices may appear relatively expensive, the return on the investment is very attractive, such that the equipments will pay for themselves in from three to seven years, depending on local conditions.

These equipments include:

1. *Generator Voltage Regulators and Load-ratio Control Equipments.*

Obviously the proper regulation of voltage at generating stations and at primary substations, will directly reduce the size and cost of the various feeder regulating devices required on the branches of the system.

To maintain proper bus voltage at the generating station there is available a complete line of generator voltage regulators for all applications, which are quick acting and of much simpler and sturdier construction than those previously used. To maintain voltage at the main substation a complete line of load-ratio

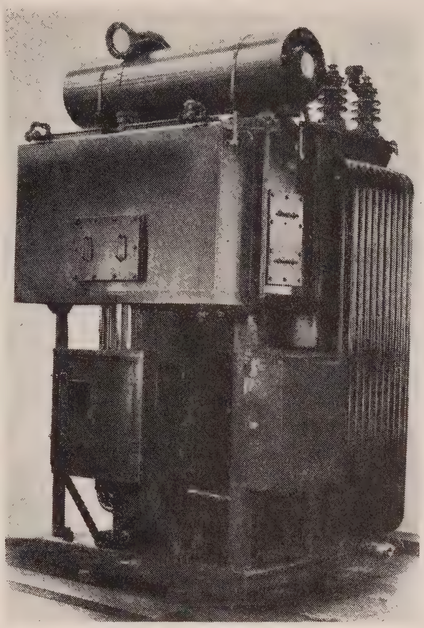


Fig. 6

control equipments is available to change transformer taps under load. These devices can be made completely automatic, so that, regardless of other conditions, a proper supply voltage will be provided to the distribution system.

Fig. 6 illustrates a transformer equipped with load-ratio control, in which a double ratio adjuster, and a contactor assembly, are contained in separate oil-filled compartments, and the driving mechanism and control panel are contained in weatherproof housings. The driving mechanism, controlled by a contact-making voltmeter, opens and closes the contactors, and changes the ratio adjusters in sequence, so that taps are changed without interrupting the flow of current.

This equipment is typical of the complete range of such devices which have been developed for different current and voltage ratings.

Equipments of this kind may be all that are necessary for good voltage regulation in certain applications, such as, a low-voltage network where the load is concentrated and where each section has about the same load characteristics as any other section.

2. *Station Type Induction Voltage Regulators.*

Good utility practice dictates that for urban circuits voltage variations, at the point of utilization, should be within plus or minus 3½ per cent., or a total range of 7 per cent. Assuming that the bus voltage is constant, that there is 3 per cent. drop in the distribution secondary, 1½ per cent. drop in the distribution transformer, and 1 per cent. drop in the primary lateral, this means that the maximum permissible drop, from the bus to the load centre is 1½ per cent. To keep within this limit the regulating device must operate frequently, it must operate quickly, and it must closely approach the desired voltage.

The wide acceptance of the station type induction voltage regulator has demonstrated its suitability for such service on urban distribution circuits.

The single-phase induction voltage regulator is essentially a two winding transformer, whose primary is excited from the supply circuit, and whose secondary is in series with that circuit. The primary is wound on a rotor which is concentrically assembled with respect to its stator, on which the secondary is wound. Since the voltage induced by the primary, in the secondary, is dependent on the angular position of the rotor relative to the stator, any change in this position will result in a change in the secondary voltage. Thus the induction regulator furnishes the infinite number of variations to the supply voltage, so necessary for urban distribution. The regulator is driven, through a worm and segment by a high-speed, reversible operating motor which is controlled by the automatic auxiliaries that function as circuit conditions dictate.

Usually, for ordinary distribution service, single-phase regulators are used, connected from line to neutral on the 4,000-volt circuit. Single-phase regulators have the advantage that they may be independently controlled, each to respond to conditions on the phase to which it is connected. While the three-phase load may be approximately balanced, the loadings at any one time may be quite different, necessitating different degrees of regulation. If the load on the various phases is essentially the same at all times, a three-phase regulator may prove economical.

Fig. 7 illustrates a typical outdoor regulator, which is complete with its operating mechanism and control panel housed in weatherproof compartments.

The station type regulator has its greatest field of application on circuits of from 100 to 500 amperes at 2,400 or 4,800 volts. It has been

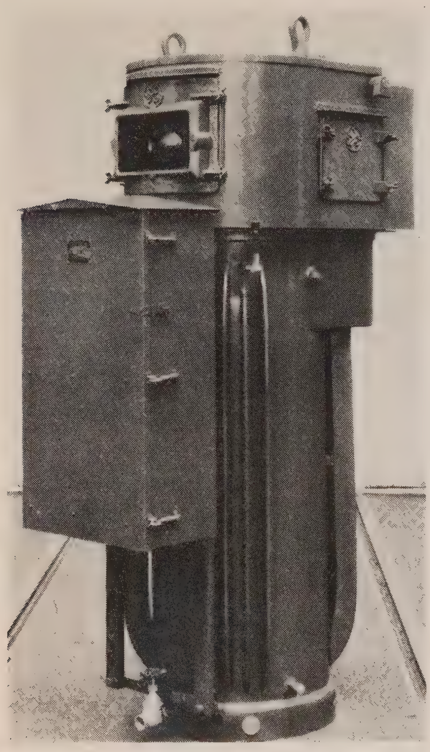


Fig. 7

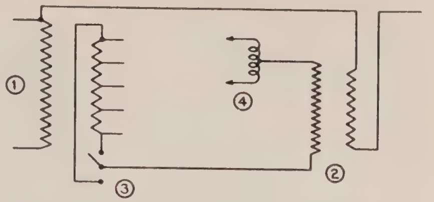


Fig. 8

found that on such circuits, the regulators will usually pay for themselves in from three to five years, by maintaining normal voltage at the load during the peak-load period.

3. Regulating Transformers.

For higher currents and higher circuit voltages than can be economically handled by induction voltage regulators, the regulating transformer has its field. Fig. 8 is the wiring diagram of a typical unit, which consists of an excitation transformer and a series transformer connected through a load-ratio control equipment. The excitation transformer, or auto-transformer is furnished with taps on its secondary. The low voltage winding of the series transformer is connected through the tap changing equipment to these taps, so that the voltage impressed on it is dependent on the tap to which it is connected. The other winding of the series transformer is connected into the supply circuit so that the voltage induced in it serves to boost or lower the circuit voltage.

As can be seen, these equipments change the voltage in a number of steps. This characteristic may not be objectionable within their sphere of application. Usually, feeders carrying a load of 500 amperes or more, are industrial circuits with a preponderance of motor loads. In such circuits an abrupt change in voltage is not so objectionable as in those where the lighting load predominates. At higher voltages their operation is usually in conjunction with other regulating devices.

4. Branch-feeder Induction Regulators.

These equipments operate on the same principle as the station-type

regulators. However, they were developed for operation on lightly loaded feeders, which do not justify the cost of the station units, so they have been considerably simplified to reduce the cost.

These pole mounted regulators serve admirably to supplement the station regulators on lightly loaded branch feeders (up to 100 amperes) such as exist on the outskirts of cities. They are especially designed for this service being timed to lag the station unit in response and thus prevent hunting. Also on long lines, while it may be possible to maintain voltage at the load centre, the voltage variation over the line may be too great, as in a suburban circuit five miles long. This type of circuit can be successfully regulated by installing branch-feeder regulators out on the line, each adjusted to control the voltage from its point of installation to the next regulator.

5. *Branch-feeder Step-voltage Regulators.*

The branch-feeder step-voltage regulators roughly parallel, in rating, the branch feeder induction regulators at somewhat lower cost. They are small, simple and inexpensive, for installation on circuits which do not justify, from economic and service viewpoints, the smoother type of voltage regulation furnished by the induction regulators, such as rural distribution circuits. They are available up to 6,900 volts (12,000-volt grounded neutral circuits) up to approximately 100 amperes.

The equipment consists of a core-and-coil assembly, a switching mech-

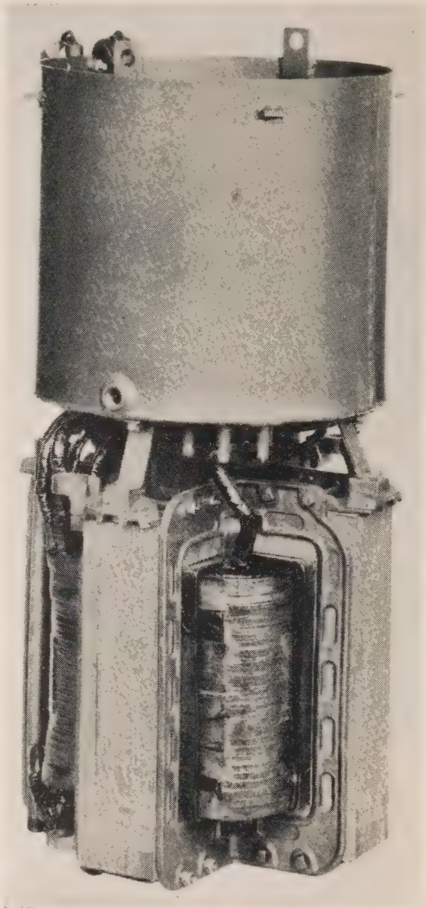


Fig. 9

anism and motor, and automatic-control equipment. The core-and-coil assembly (Fig. 9) is oil immersed in a distribution-transformer-type tank, having hangers for pole mounting. The switching mechanism and motor (Fig. 10) are oil immersed in a separate tank which is mounted above the core-and-coil assembly inside the main tank. The automatic-control equipment is contained in a weatherproof cabinet which can be bolted to the main tank, or else

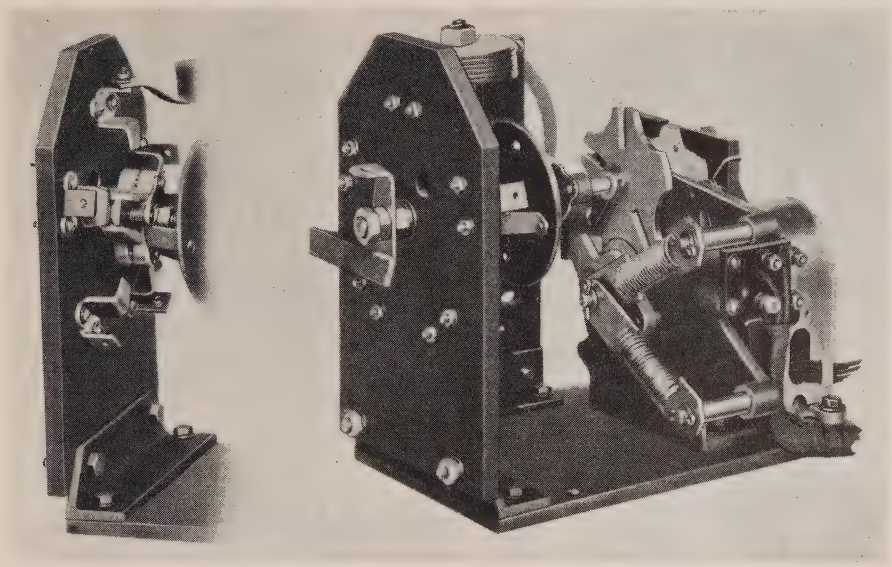


Fig. 10

mounted at the base of the pole. Fig. 11 illustrates a completely assembled unit.

The core-and-coil assembly is essentially an auto-transformer with an extended winding having a number of taps. The switching mechanism is connected across these taps so that, within the limits of the equipment, the output voltage is held essentially constant. An ingenious terminal board arrangement permits the standard unit to be connected for 10 per cent. boost or 10 per cent. buck and various combinations between these limits.

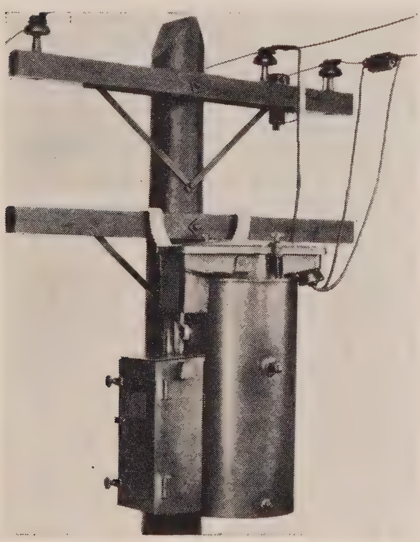


Fig. 11

6. Branch-feeder Step-voltage Boosters.

The rural customer, to be satisfied with the operation of his power consuming devices, must have his voltage held within reasonably close limits. Unfortunately the revenue to be derived from long, lightly-loaded, circuits is small, and therefore, capital expense is kept to a minimum. Consequently, a small conductor is used, and unless regulation is provided, voltage variations with

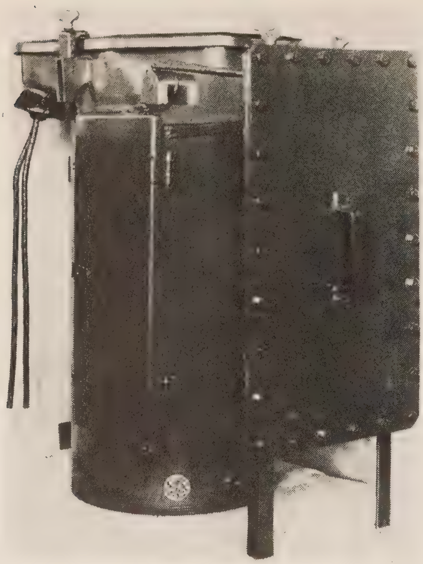


Fig. 12

different loads are considerable. Realizing that the increased revenue through maintaining proper voltage

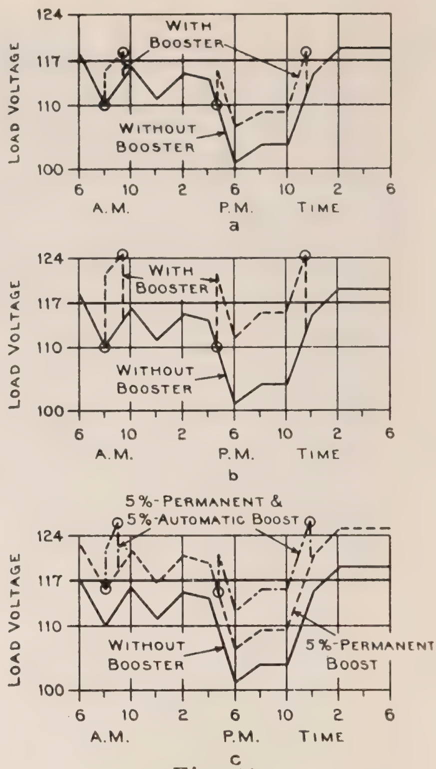


Fig. 14

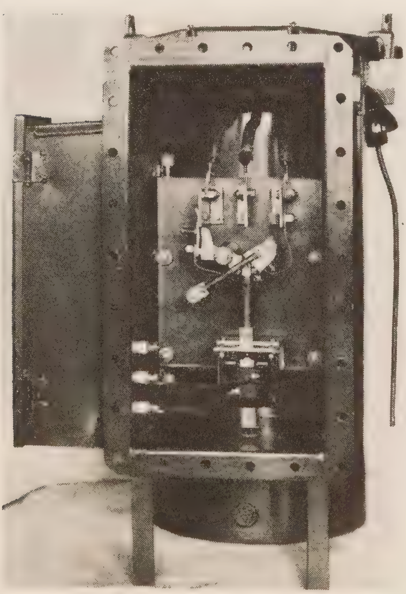


Fig. 13

will be small, a simple, inexpensive, one-step booster has been developed. It too, is an auto-transformer with a two-position contactor which changes from the "no boost" to "full boost" position automatically as load conditions dictate. The boosters are available for operation on 2,400, 4,000, 4,800, 6,900, 8,000 or 12,000-volt circuits for relatively small currents. They can be connected for either 10 per cent. or 5 per cent. automatic boost or 5 per cent. permanent boost and 5 per cent. automatic.

These devices have been made as simple and rugged as possible to permit their installation on poles at considerable distances from the sub-

station. More complicated devices, having a greater number of positions, require more elaborate control equipment, necessitating more frequent adjustment and servicing. If installed several miles from the station, their maintenance cost greatly exceeds that of the booster.

Fig. 12 shows a complete unit, while Fig. 13 illustrates the solenoid-operated contactor assembly.

These equipments are the cheapest of the voltage regulator family and as such, should be considered only for applications requiring few operations per day, and where the sudden change in voltage will not produce complaints of unsatisfactory performance.

Fig. 14 is a voltage chart of a circuit on which these units were installed. It can be seen how the booster operates at definite periods as load conditions dictate, and serves to give a great improvement in voltage conditions during the peak periods.

Line-Drop Compensation

The line-drop compensator is an important adjunct to voltage regulating devices. As its name implies, it introduces an element of voltage into the control circuit proportional to the impedance drop from the regulator to the feeder load centre. This gives the regulator a compounding characteristic and provides the desired voltage, under all load conditions, at the load centre.

If transformers are tapped off the entire length of the feeder, the limit of compensation is established by the allowable overvoltage on the transformer nearest the regulator. However, reconnecting the transformers so that each feeder has a well-defined load centre, will usually result in much better voltage conditions, with its attendant benefits.

All of the equipments described above, except the booster, can be supplied with line-drop compensators.

Induction Regulators vs. Regulating Transformers

In considering the application of regulating equipment there is often a choice between an induction regulator and a regulating transformer. In the induction regulator, the voltage is changed uniformly as contrasted with definite steps in voltage obtained by changing taps on a transformer. With the latter, the control device must be given a fairly wide setting to prevent too frequent operation of the tap changer. Thus, the induction regulator can operate on a much narrower "band width" than can a regulating transformer, and will, therefore, maintain much closer regulation at the load centre.

Also, with a regulating transformer, to reduce wear on the contacts, a time-delay relay must be furnished to prevent operation of the tap changer under sudden voltage dips. Therefore, its time of operation will be much longer than will the induction regulator, particularly since the time delay is introduced as each step is completed.

Thus, in many cases, particularly on urban circuits, the induction regulator will prove to be the most economical equipment even at a higher cost, since it operates as soon as a voltage change is required and the

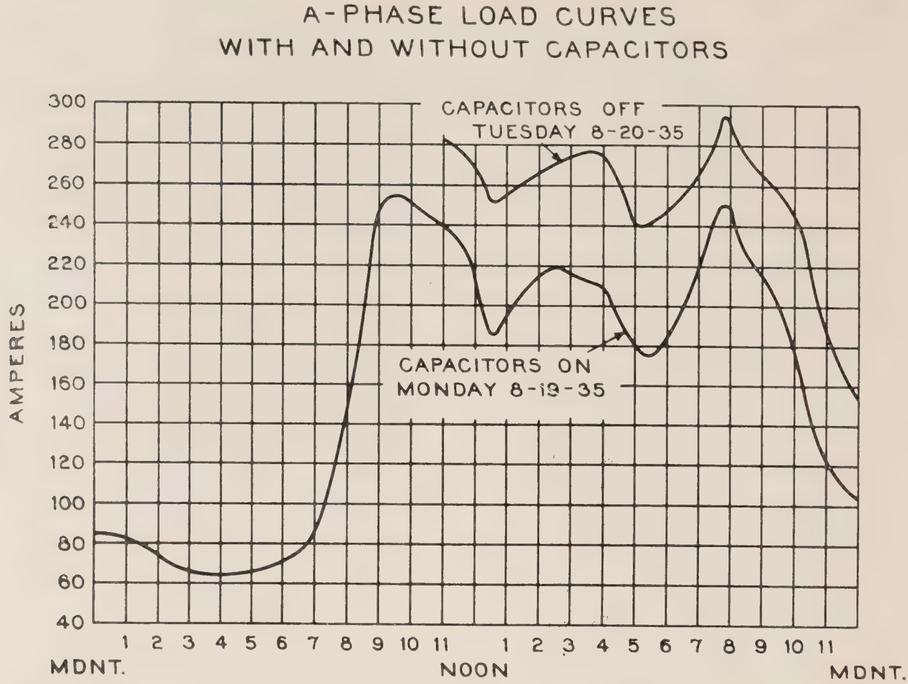


Fig. 15

required voltage is more closely approached.

The Shunt Capacitor

The shunt capacitor offers great possibilities as a means for economically improving voltage conditions and relieving overloads on distribution circuits. It is doubtful if these possibilities are fully realized by all distribution engineers. The recent development of a light-weight, fireproof, sturdy capacitor unit, suitable for pole mounting, has made possible the application of shunt capacitors for installation at various points on the distribution system.

The capacitor is installed near the end of the distribution circuit, and by drawing a leading current through the line gives a definite increase in voltage all the way back to the generating station. This voltage rise is permanent and fixed, and is independent of the magnitude or power factor of the load.

By improving the power factor of the circuit, the load current is considerably reduced. One installation by a large American utility, consists of two 180 kv-a., 4,000-volt capacitors on a city distribution circuit. Fig. 15 shows the load curve on this circuit with and without the capacitor connected. The current reduction, by the addition of these capacitors, resulted in a reduction in voltage drop in the load area from 8.2 volts to 4.6 volts. A voltage variation of 6 volts (plus or minus 3 volts) is considered satisfactory by this utility, so, since the

voltage drop varies almost directly with load, an increase of 30 per cent. in load is permissible without exceeding the allowable limits of regulation.

Due to load growth, if capacitors had not been installed, it would have been necessary to install a new feeder to relieve this circuit of some of its load. The installed cost of the capacitors is somewhat less than the annual carrying charges on the investment in the new feeder. As a result, each year the capacitors forestall the necessity of the new feeder, they will pay for themselves in carrying charges alone. In addition, there will be a saving in feeder losses, because of the reduction in the load current of the circuit, as well as increased annual revenue due to the higher average circuit voltage.

The Series Capacitor

The series capacitor has a place in the distribution field where excessive voltage drops necessitate reducing the circuit impedance. Intermittent loads, of low power factor, such as arc furnaces, steel mills, electric shovels, etc., cause voltage swings so rapid that they cannot be corrected with ordinary regulating devices.

The series capacitor neutralizes the inductive reactance of the circuit, and thus reduces its effective impedance. In this way the voltage regulation is greatly improved, and since there is less impedance, wide load swings will have much less effect on the system voltage.

Fig. 16 shows a series capacitor installation which has satisfactorily solved a problem of voltage flicker due to intermittent loads, at a cost of only one-third of the cost of supplying sufficient circuits to accomplish the same result. At the same time, it has increased the load capacity of the circuit by more than 40 per cent.

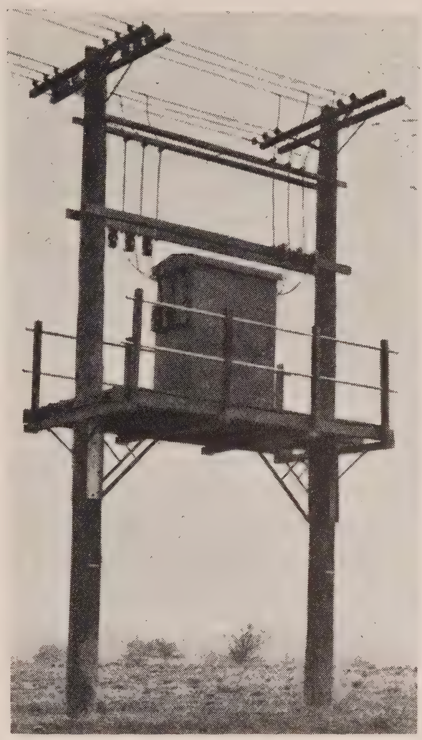


Fig. 16

Summary

The permissible loading of distribution feeders, has been dictated, in many cases, by the allowable voltage drop, whereas the cost of the circuit losses should be the deciding factor. In Canada, with low cost power, the cost of losses will permit higher loading per circuit than will the consideration of voltage drop.

With regulating equipment for practically all applications, at reasonable cost, each circuit can carry

heavier loads. Thus, the necessity of building new feeders for growing loads, is deferred, thereby reducing capital expense and carrying charges.

The particular applications for which each device is most suitable, may be summarized as follows:

1. Generator voltage regulators and load-ratio control are necessary to assure a constant supply voltage and thus reduce the cost of the other regulating devices.

2. The induction voltage regulator is recommended for city distribution circuits where close regulation and minimum time delay are important.

3. Regulating transformers may be applied to industrial circuits of high capacity, and to high voltage feeders.

4. Branch-feeder induction regulators were developed for suburban and lightly-loaded urban distribution circuits which require, at lower cost, the same class of service as provided by the station type regulator.

5. Branch-feeder step-voltage regulators are offered for suburban and rural circuits which do not justify the greater cost of the induction regulators.

6. The branch-feeder step-voltage booster can be used on rural circuits which require a change in voltage a few times a day.

7. Shunt capacitors may prove economical for circuits which are loaded to capacity, and which have an excessive voltage drop.

8. Series capacitors may be the only solution for circuits feeding intermittent loads which cause wide voltage swings.

Conclusion

The utility systems of Canada, with the active support of the electrical manufacturers, are continuing all their activities in the field of load building. There is still a long way to go before the saturation point is reached with existing appliances. Before that point is approached the fields of air-conditioning; building heating; wider use of light—not only as a source of illumination but as a form of decoration; as well as uses at present unknown, will open up new conceptions of the possibilities of the domestic and commercial load. The present utility load requires good voltage regulation—not only to assure satisfactory operation—but also to give the utility the revenue to which it is entitled. If the present load needs good regulation, what of the future when load densities may be doubled, and when the consumers are even more dependent on electric service than they are today?

It is of utmost importance that voltage surveys be made a regular part of the operating routine so that frequent checks may be obtained on the actual voltage on the consumers' premises. These surveys will eliminate complaints, but more than that, they will pay for themselves in the revenues that are now being lost due to high or low voltage.

Periodic consideration must be given to the necessity of a change in the method of distribution. It must be kept in mind that when a change appears desirable, it should be made at once since the cost of the changeover will be higher with a higher load density, and the economies of the

new system will be wasted until the change is effected.

In the demonstration which follows, an application of station-type induction voltage regulators to a typical urban distribution circuit is discussed. An attractive return on the investment is indicated, and the cost is compared with the cost of achieving the same results by using larger conductors. On suburban and rural circuits of lower load densities, similar attractive investments can be shown. While the actual revenue is less, the less expensive pole-type induction regulators, step-regulators and boosters will result in as high, and sometimes even higher, return on the capital invested.

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The Satellites of Jupiter

THE discovery of Jupiter's satellites was one of the most important events in the development of the science of astronomy. It marked the introduction of the telescope and the consequent enlargement of the field of study: it also was the turning point from the earlier conceptions of the visible heavens to the more modern scientific ideas of the whole Universe.

In January, 1610, Galileo Galilei was Professor of Mathematics at the University of Pisa, Italy. At that time the Copernican theory,—that the sun is the centre of our solar system and that the planets move in orbits around it,—had been accepted by many in place of the older theories of Ptolemy and others who believed the earth to be the centre. There was, too, a very strong prevailing notion that, as seven was considered the perfect number, there could not possibly be more than seven planetary bodies in the heavens,—the Earth, the Moon, Mercury, Venus, Mars, Jupiter and Saturn.

Galileo, however, was a man who would not fully accept theories until he had proven them to his own satis-

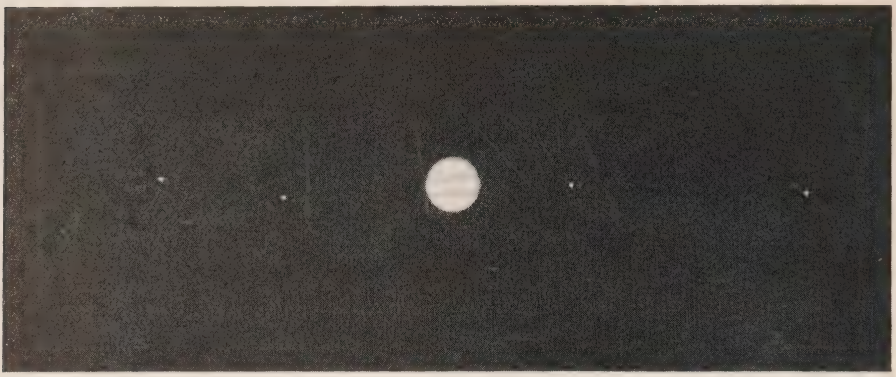


Fig. 1—"Jupiter has four moons attendant upon him."—Galileo.

faction by experiment and observation. He had already dropped two different weights, one pound and one hundred pounds, from the Leaning Tower to prove that all bodies fall to ground through a given distance in the same length of time, quite independently of their weights, and thus had he upset Aristotle's theory to the contrary which had been accepted and had stood unchallenged now for nearly two thousand years.

Galileo, too, had built himself a telescope, composed of only two small lenses, and had demonstrated its merits from the Tower of St. Mark's, in Venice, to the learned men of that city,—and now he turned it toward the Sun, the Moon, —and Jupiter.

The Sun had been considered a perfect heavenly body,—but Galileo found dark spots upon it. The Moon had been considered perfect also, except where tainted in patches due to the sins of the people on the earth,—but Galileo found mountains over a large part of its surface: it, therefore, was not celestial and individual, but very much like the earth. If these observations then were to be believed, both the Sun and Moon would lose their status of perfection.

Bad, however, as the situation had now become, this was not the worst of it, for Galileo announced that "Jupiter has four moons attendant upon him" and that they move around him in their orbits. It was a fact: he had seen them through his telescope.

This discovery severely threatened the existing popular notion as to the perfect number seven and, consequently, it aroused disagreement and heated argument, though little of weight, scientifically, could be found to support the old conception. Nevertheless, there were many persons who refused to look through Galileo's telescope for fear they would see that which they did not dare to believe.

An astronomer in Florence, having heard of Galileo's discovery, wrote to him as follows:—"The satellites of Jupiter are invisible to the naked eye, and therefore they can have no influence on the Earth, and there-

fore they are useless, and therefore they do not exist." Galileo's reply was very definite: he said that all the force of argument which may be brought to bear on this matter to prove that the moons were not possible, could have no weight whatsoever once they had been seen. The controversy waxed ever warmer; even Galileo's life was threatened. Finally, he was dragged before the Inquisition and, under oath, made to deny the facts of the existence of sunspots, lunar mountains and satellites possessed by Jupiter,—but, said he, they are there just the same.

Through a transit, field glass, or other telescope, having a magnifying power of six diameters or higher, Jupiter and these four moons, Fig. 1, may easily be seen. The planet will be in the evening sky throughout this summer and the satellites will be in different positions each evening. With a more powerful instrument the fifth moon, discovered by Barnard in 1892, may even be visible.

When telescopes of greater power had been developed, and photography applied, four more moons were discovered in Jupiter's retinue, —a total of nine, some of which travel with retrograde motion, the reverse of the customary direction, around the planet, and the orbits of two moons interlock, as two circular links of a chain with the planet in the planes of both.

Jupiter has a reputation for "capturing" moons and otherwise disturbing the movements of various celestial bodies in the solar system. One comet, for instance, which re-

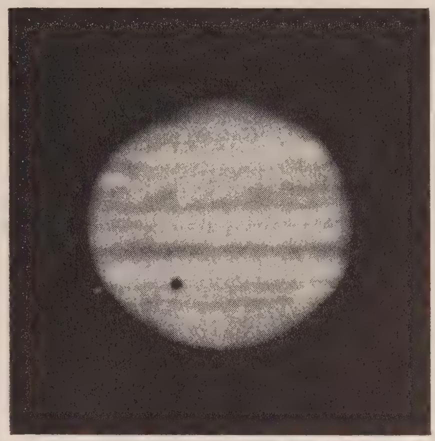


Fig. 2—The satellite Gannymede, at left, casting its shadow on Jupiter.—Mt. Wilson Observatory.

turned regularly in a very long period, came under Jupiter's attractive influence, and was drawn out of its course to such an extent that for a time it returned every six years, but finally, while passing near this planet again, it was so drawn from its new course that it has never returned.

Jupiter is the largest planet of our solar system, having a diameter about ten times that of the earth. It is to be expected, therefore, that it will have some special influence on other members of the system.

When viewed through the telescope, the planet always appears to be a full disc, or very nearly so,—not passing through quarter or crescent phases, as Venus, Mercury and our moon,—and the satellites appear full also when their discs can be seen clearly. The planet, however, has not a sharply defined edge but appears to be covered with clouds and to have two irregular dark bands crossing it.

Jupiter's period of revolution around the sun is nearly twelve years, and the periods of the four readily visible satellites about the planet, in accordance with their distances from it, are as follows:—

The Galilean Satellites

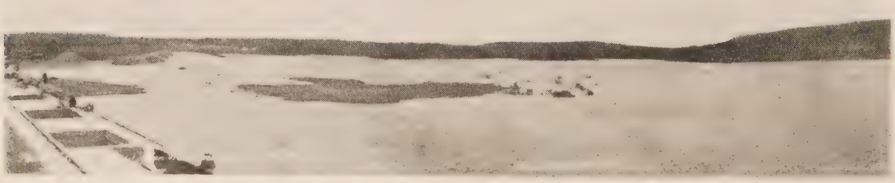
Number	Name	Diameter	Distance from Planet	Period
I	Io	2,460 Miles	262,000 Miles	1.75 Days
II	Europa	2,000 "	414,000 "	3.50 "
III	Gannymede	3,540 "	655,000 "	7.00 "
IV	Callisto	3,350 "	1,169,000 "	16.66 "

At intervals these moons pass behind the planet and therefore disappear, eclipsed, in its shadow for short periods, whereas at other times they cross the planet's disc and cast a small circular shadow upon it, Fig. 2, at which time a solar eclipse is taking place.

The dates and hours of the transits of the first three of the brightest satellites across the planet's disc, and also of their disappearance and reappearance when they pass behind the planet, events which occur at every revolution with these particular satellites, are listed in the Nautical Almanac and also in several other annual publications. This information, while not of general interest, is used by navigators of the seas as a means of checking their chronometers.

Discrepancies are observed in the regularity of the satellites' travels around the planet. These variations, however, are apparent only and are due to the different periods of time required for light to travel from Jupiter to the earth,—from 30 to 50 minutes,—according to the relative positions of these two planets on their orbits and the consequent direct distance between them. These seeming discrepancies have been used as a convenient means of checking the velocity of travel of light through space.

While some other planets have satellites, there being a total of twenty-seven known in the solar system, those of Jupiter, as a group, are the most readily seen and, undoubtedly, are the most interesting to observe.—*F. K. D.*



THE BULLETIN

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Convention Notes

THE papers and demonstrations at the summer convention of the Association of Municipal Electrical Utilities at Ottawa on July 2nd and 3rd were all of exceptionally high quality and contained a bulk of valuable information. His Worship, J. Stanley Lewis, Mayor of Ottawa, who incidentally is connected with the electrical industry, welcomed the delegates to Ottawa, and pointed out that the electrical industry was Canada's key industry which would see rapid expansion in the near future.

C. E. Schwenger, Distribution Engineer, Toronto Hydro-Electric System and Chairman of the A.M.E.U. Committee appointed to consider the same, presented a report from the committee on the draft specifications submitted under the direction of the Canadian Electric Standards Association covering "Construction of Overhead, Underbridge and Underground Crossings Involving Railways, Supply Lines and/or Communication Lines". This report will be published in a future number of *The Bulletin.*

The paper, "The Economic Regulation of Distribution Circuits", by A. M. Doyle, Commercial Transformer Engineer and M. J. McHenry, District Manager, Canadian General Electric Company, Toronto, (see *The Bulletin* for June) was followed by a demonstration. By means of portable apparatus representing a distribution feeder circuit with branch lines, and suitably calibrated meters, Mr. McHenry illustrated the effect as to voltage regulation with various loadings and sizes of copper and how the regulation could be kept within desired limits by the installation of feeder regulators more advantageously than by increasing the sizes of the conductors. This demonstration was particularly convincing.

J. C. Smith, Dominion Gas and Electric Inspector, London, in his talk on "Proper Meter Maintenance", which he illustrated with a large number of charts and micrographs, showed that the increased revenue due to

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July, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

proper cleaning and repairing meters when brought in for re-inspection could more than compensate for the cost of such maintenance.

The paper "Advertising for the Hydro Utility", by F. C. Adsett, Assistant Engineer, Municipal Engineering Department, Hydro-Electric Power Commission of Ontario, is to be found in this issue.

An account of the new promotional activities of the National Electric Contractors Association was given by Laurence W. Davis, General Manager. He described the efforts being put forward in the United States to organize the whole electrical industry so as to co-ordinate all parties to do a constructive selling job, and presented it as a thought for the adoption of the same principle throughout Canada.

The address by Samuel G. Hibben, Director of Applied Lighting, Westinghouse Lamp Company, Bloomfield, N.J., entitled "New Horizons in Lighting" was accompanied by demonstrations in which he illustrated the working of lighting units and the effects to be obtained. His whole demonstration was most spectacular and was thoroughly enjoyed by all who were privileged to witness it and both he and the Westinghouse Company are to be congratulated on the thought and care that has been given to develop and illustrate the possibilities in the application of electricity to lighting.

Beginning with the tungsten lamp of the present grade of manufacture he showed the absolute necessity of perfection in its making, illustrating the effect of traces of air, moisture or other foreign substances on its life. After producing "cold light" chemically, he passed to the various forms of vapour lamps. He showed the varieties of colours of light resulting from the ionization of different gases; how the invisible ultra-violet ray could be used to change the colouring of dyed and impregnated fabrics; and colour effects that can be produced with the use of different types of lighting.

Discussion of the Hydro-Electric Range Campaign was introduced by G. J. Mickler, Sales Department, Hydro-Electric Power Commission of Ontario. He described the progress in the two months following its inauguration on April 15th and the discoveries made regarding intensive selling of ranges. J. E. B. Phelps, Manager, Sarnia Hydro-Electric System, and V. A. McKillop, Engineer, London

Public Utilities Commission, described the efforts put forward and the results obtained in their respective municipalities in co-operating in the campaign.

At the breakfast session, conducted by the Committee on Accounting and Office Administration, on the morning of Friday, July 3rd, there was a discussion on "Stub Plan Billing", and a paper by I. N. Pritchard, Public Utilities Commission, Chatham, entitled "The Inactive Ledger".

Exactness of Modern Science of Weighing and Measuring

The following article, which appeared in Miscellaneous Publications M122, National Bureau of Standards, may be of interest to the readers of *The Bulletin:*

> "The science of weighing and measuring has become so exact that experts in this field are able to weigh to one part in a billion or to talk and work to a millionth of a second or a billionth of an ampere.
>
> "Testing machines which can apply tensile loads up to a million pounds and compressive loads of 10 million pounds are now in use. They accurately measure loads up to a thousand tons or the force required to crush an egg or to break a horsehair.
>
> "Means have been devised to rule 50,000 or more lines within 1 inch, straight and parallel, exact to a millionth of an inch. Such a ruled surface has the power to analyze a ray of light from a star or atom, to tell its composition, and to disclose its structure.
>
> "Temperatures ranging from absolute zero (459 deg. below zero Fahrenheit) to temperatures hotter than the surface of the sun (10,000 deg. Fahrenheit) can be measured.
>
> "Countless other achievements have been made possible because of the exactness of the modern science of weighing and measuring.
>
> "The leading countries of the world have adopted certain standards for weighing and measuring, and international co-operation in this field has been established."

Upstream view of Tretheway Falls development on the South Muskoka River.

Advertising for the Hydro Utility

By F. C. Adsett, Assistant Engineer, Municipal Engineering Dept., H.E.P.C. of Ontario

(Presented to Association of Municipal Electrical Utilities at Ottawa, July 3, 1936.)

ADVERTISING is an Aid to Selling and therefore justifies a certain measure of expenditure. It eases the task of selling, just as lathering eases the work of shaving and saves time in the operation. The better the lather the easier the shave, and similarly in selling anything, the better the advertising the easier it is to make the sale. If advertising had never been developed, who can imagine how much selling expense would be involved every time a salesman tried to sell you his recommended brand of coffee, tooth paste or electric lamp bulbs. The fact that advertising has permeated our business structure to its present degree of importance is convincing evidence that it is considered to be worth its cost.

For our particular business it seems that advertising lends itself to our economical use, in that it permits us to do something tangible towards increasing the sales of electrical appliances and service throughout our communities. This tangible assistance to the sale of electrical equipment which may be rendered by advertising, is the creation of desires in the minds of our citizens for electrical helps in the home, better lighting, and the latest electrical processes in industry.

In dealing with the subject, "Advertising for the Hydro Utility," may we discuss it under the following headings:—

WHY ADVERTISE

There is an old axiom, which most of us have heard over and over, that if a thing is worth doing it is worth doing *well.* I expect we are unanimous in believing that we are engaged in a worthwhile undertaking, that we are supplying our communities with a most essential service, and that the operation of our Hydro Utilities entails a great measure of responsibility. Undoubtedly it is a job worth doing. But can we say that we are doing this job well if we neglect to tell our public how they can use Hydro service to the best advantage, or how they can save their health, their eyes, their time and their money? And are we doing our jobs well if we fail to supply our consumers with electric service at the lowest possible cost, which is feasible only when our lines and electrical equipment are loaded throughout each of the twenty-four hours? With regard to this latter point, I would like to emphasize that the possibility for lower rates in a large number of Hydro municipalities is almost directly contingent upon a greater consumption of power in these municipalities. You can visualize this possibility any time you see a Hydro line if you will ask yourself the question, "How much less would this line cost per kilowatt-

hour transmitted, if it were fully loaded during the day and night?" Such possibilities are beyond estimation if the same deduction is applied to all primary lines, secondary lines, transformers, meters, substations, etc, and indicate that each additional load connected any place on our lines is just one step nearer our common objective,—the best possible service at the lowest possible cost. To reduce the cost per kilowatt-hour, therefore, we must load up our lines and equipment more continuously throughout each twenty-four hours. Can this be done?

Electric Light and Power Utilities everywhere are wrestling with this task of increasing their business, making more complete use of their lines and equipment, and so reducing the cost per kilowatt-hour of distribution and operation. Many of our Hydro Systems have shown real progress in the cultivation of loads, as will be gleaned from an examination of Section "D" of the Annual Reports of the H.E.P.C. over a period of years. For the London Hydro System, for instance, the average monthly consumption per domestic consumer in 1915 was 21 kw-hr.; in 1920 it had grown to 44 kw-hr.; in 1925 it was 104 kw-hr.; in 1930, 160 kw-hr.; and in 1935, 225 kw-hr. These figures indicate an increase over the twenty-year period of more than 1,000 per cent., or, if calculated on a yearly basis show an average annual growth of 12½ per cent. over each preceding year. This progression of increasing domestic consumption pictures to us a continuous stream of new ranges, water heaters, refrigerators, etc., connected every month, with the result that the lines, transformers and meters are working longer hours and are handling many more kilowatt-hours than formerly. Such an achievement reduces the cost of distribution and operation per kilowatt-hour, and surely is part of our responsibility as Hydro operating executives.

Further investigation will show that although some Hydro systems have been favoured by various circumstances so that increased business has come to them like flies to the lazy frog, others have obtained their enviable growths in consumption per consumer only by dint of hard work. They have sold appliances for the home, better lighting wherever lighting is required, and have interested themselves energetically in electric processes for industrial consumers. These municipalities have felt the urge to tell their consumers how to use Hydro to the best advantage so as to save their health, time, and money, and have rendered a real service to their consumer-owners. They have endeavoured to do their work well.

The extent to which the direct selling of electrical appliances and apparatus should be carried out by Hydro utilities, is a debatable question, and is not intended to be settled in this article. The Toronto Hydro-Electric System is prominent amongst those utilities whose advertising implies that electric ranges, refrigerators, etc., may be secured either from its Hydro Shop, or from the many electrical dealers throughout the city. These utilities are pushing the sale of appliances as a means of increasing Hydro consumption, regardless of

which retail outlet makes the sale to the consumer. It would seem hard to criticize or to improve upon such a policy. A pertinent question to ask, therefore, is, "If *we* do not push the electrical business, who will?"

There are a few utility executives, who maintain that public ownership principles excuse them from approaching their consumers in search of new business, as done by private corporations. When requested by consumers for help with electrical problems, of course they are prompt in giving excellent advice and very practical assistance. But as officials of Hydro Systems, they argue that their duty should not include the interference of any consumer's business by suggesting that he use more power here or more current there. For viewpoints so sensitive I would say that the Better Light—Better Sight Campaign has demonstrated once and for all the unfairness and inhumanity of continuing to serve our consumers without telling them about decent lighting requirements for themselves, their employees and their children. It may be established, therefore, that each Hydro System should assume the responsibility for spreading the doctrine of adequate lighting amongst its citizens.

To what extent we should urge the purchase of modern lighting equipment by our consumers is a matter for each individual municipality to decide for itself. It seems logical to suggest though that if the Better Light—Better Sight idea is given the right amount of publicity, the consumer will be capable of apportioning a proper share of his means towards improving the lighting of his home. The advertising objective in the Better Light—Better Sight Campaign, therefore, might be considered as that amount which will so interest Hydro consumers in the idea that they will give the matter their serious attention and buy better lighting equipment to the extent of their financial ability. I want to emphasize this point, if I may, because I have heard some who are members of this very organization ask the question, "Why worry your consumers with advertising all the time, and why the expense of it all?" The answer, firstly, is that if we are to keep our loads growing so as to furnish economical service, *we must endeavour to secure for the electrical industry a proper share of our consumer's dollar.*

What applies to better lighting, applies also to electric cooking, water heating, refrigerators and electrical appliances in general. With so much advertising before the public, electric service must compete with the automobile industry, the home furnishing trades, the clothiers, the theatres, etc., and will receive little consideration for a proper share of the family budget if not upheld favourably in the estimation of those with money to spend. And might it be mentioned here, that during the years 1930 to 1935 it was our domestic consumptions which suffered the least from the effects of the depression. Accordingly, the family budget is of special interest to us in our efforts to secure a dependable market for Hydro service.

The second reason for advertising has been mentioned already, viz.: *The education of our consumers and prospective consumers* regarding electrical appliances and equipment available for

their use. If your average consumer does not know as much about air-conditioning as he does about perfected hydraulic brakes, or alkalinity producing cure-alls, the chances of that consumer installing air-conditioning equipment are remote indeed. We have made a little progress, it is true, since the old days when our consumers asked for a "Thirty-two calibre lamp," or a "Six horsepower fuse plug." But the progress has not been overdone.

A further justification for using advertising space, is the occasional opportunity *to acquaint our consumers with Hydro affairs of interest to everyone.* This might be a new building, a change in policy, or possibly just one of the frequent reductions in rates to Hydro consumers. Is not this an occasion that can benefit from a little spread in the local newspaper, showing the public how the new rates work out for a 40-watt lamp, or an electric range? Competing industries always capitalize such reductions in the prices of their products and frequently run full-page advertisements to make such important announcements. It is safe to say that a Hydro municipality with an aggressive merchandising programme will not neglect the occasions of rate reductions to remind its citizens that *Hydro is yours, use it.*

One of our famous writers has said, "If you want a thing done well, do it yourself," and yet this advice has been ignored consistently by some of our Hydro Utilities. I think I am correct in saying that some Hydro Systems do absolutely no advertising from January 1st to December 31st, yet they must be aware of the advertising efforts some of their local dealers are making to popularize electric service in their communities. One reason for this indifference, no doubt, is a feeling of security because our business is to some extent a monopoly and certain to benefit from increasing markets for our service as new inventions are brought out. Well, in the *Journal of Gas Lighting* some fifty-seven years ago, as copied from the *Electrical Digest* of February, 1936, we read:—

"It is a noteworthy and curious circumstance that every trial of electric lighting, however successful, only serves to prove its utter general impracticability as an illuminator and the possibility of its ever in the slightest degree competing with the progress of gas lighting."

The Gas People made the same mistake fifty-seven years ago that some of us might be making now. A more recent example of similar complacency might be cited from the records of the railroad industry over the past twenty years. Modern invention might be termed a "doubtful friend" because it is sure to introduce some new competition to our service before many years. At the present time the Natural Gas Companies are planning bigger and better sales activities in certain growing areas of Western Ontario that will compete with us in cooking and water heating. Diesel engines are more common than ten years ago for power purposes, and in one instance have cut in on us right in the City of Toronto. I recall reading a short time ago about a luminous paint, possibly similar to that used on

luminous watch dials, which may be applied to the ceiling of a room, is sold at a certain contract price per square foot, and will continue to give ample illumination twenty-four hours per day for a large number of years. I did not read how they were intending to adapt this kind of lighting for bedroom use when one wishes to go to sleep, but nevertheless I believe that the shadow of a new competitor has crossed our path. Inventions never stop, and perfection is only a temporary condition. Our markets for Hydro service are not guaranteed in perpetuity, so it behooves us to connect as much load as possible while we may. These are some reasons why we should advertise electric service in Ontario, *now.*

Mediums and Methods of Advertising

There appear to be two outstanding mediums at present available for Hydro Utility advertising—the local newspaper, and the practical display of electrical apparatus. Any form of publicity will have its particular advantage for keeping the idea of electrical service in the minds of our consumers, but in the matter of spending a portion of our Hydro revenue, only the most reliable methods of advertising should be countenanced if one is to avoid criticism. Local newspapers invariably provide a profitable medium for telling our consumers and prospective consumers about the advantages of electric service. Our precedent in a decision to buy newspaper space is the advertising of local merchants, who spend money on publicity for just one purpose—more sales and bigger profits.

In the first place, our local newspapers are read by people residing in the community served by our Hydro Utility. Therefore, they are most efficient and convenient mediums, because they enter the homes of those we are anxious to reach with our advertisements.

In the second place, newspaper advertising is not expensive to make up, so we can afford to use fresh advertising at frequent intervals. As a matter of fact most of the electros used for advertising lamps, appliances, etc., are furnished free by the manufacturers, consequently the only items of expense are for the time making up the advertisement and the space in the newspaper.

Another advantage of using newspapers is that we may insert an advertisement on very short notice, should it be desirable to do so. A hot day, for instance, may be chosen for telling about electric fans, refrigerators and electric ranges; a cold spell in either the Fall or Winter may be used to advertise portable heaters, electric grates, or automobile heaters. To have our advertisements serve us most effectively, this point of timeliness is extremely important. Furthermore, local newspapers are read quite thoroughly in order to secure news and bargains, also with more or less confidence, so that our newspaper advertisement has a fair chance of receiving the reader's favourable attention.

The other phase of advertising that may be made very effective is the demonstration or display of our appliances and apparatus, including window displays, demonstrations on the

floor of the office, demonstrations in the homes of our consumers, cooking schools, exhibits at fairs or carnivals, and so on.

The show-window is, perhaps, the most important of these mediums, as it may work for us every hour of the day. A display in the office window is noticed by Mr. and Mrs. Consumer when they are down street at night on a window-shopping trip, or when they go to the theatre, etc., and is a grand opportunity for us to show them how they can benefit from the installation of more electric service in their homes. The appearance of some Hydro office windows at night leaves an impression only of a curtained window, a notice concerning the hours during which bills may be paid, and in the sparsely lighted interior, a wicket through which many hard-earned dollars have passed grudgingly in compliance with a stern request to, "render unto Caesar that which is Caesar's". Such neglect of a window display possibility is not only wasteful, it is expensive, whether or not we merchandise electrical appliances. Considering that some retail establishments charge one-third of their rent to window displays, we realize that an effective window may go a long way in securing for our industry a proper share of the consumer's dollar.

In discussing show-windows, might I appeal to you to make yours an exemplary window in respect to its lighting. It is an opportunity for you to demonstrate, at very little cost, how a proper intensity of lighting will show up a window display, and will be an example to the merchants of your community. The Hydro office with a poorly lighted window is on a par with the electrician with his electric bell always out of order. Speaking of store window intensities, it is common practice in Toronto to run as high as 500 watts per linear foot in the downtown district, and 250 watts per foot in the well-lighted neighbourhood stores of Bloor Street, St. Clair Avenue, etc. Intensities may run as high as 1,000 watts per foot in large store windows which are lighted to exceed the attractiveness of their competitors' windows. A minimum of 100 watts per foot is required for attracting any attention to a store window, even in a small community.

A display on the floor of your office is one of the most effective forms of advertising, as a clever demonstration is always convincing. Moreover, a demonstrator has the opportunity to explain the appliance or lamp in detail, if the prospect is interested, and may go a step farther and arrange for a home demonstration, or possibly a sale. The cost of floor demonstrations per prospect will be very moderate if a goodly number of people are contacted, and will be amply repaid out of profits on sales, if merchandising is done. For those offices without a Hydro Shop it may be easy to arrange with dealers or manufacturers to put on floor demonstrations at times when collections are coming in. Advertising assistance in the form of demonstration kits, counter cards, etc., will be supplied by many manufacturers of electrical equipment. During the present electric range campaign, it is particularly desirable to have one or more ranges on the floor so that consumers may examine them and ask

any questions they wish; also their names may be placed on a prospect list to receive further attention.

Cooking schools have played a successful role in the Hydro Shop merchandising of the larger municipalities, as well as in others of moderate size. Range manufacturers are ready to co-operate and will share much of the expense. A cooking school at the London P.U.C. recently was broadcasted and thus reached an additional unseen audience. I think we should hear more of this method of demonstration from Mr. Buchanan, or one of the staff.

Exhibitions, fairs, carnivals, etc., are opportunities for demonstrating Hydro service, and by all means should be considered seriously before they are turned down. The work involved in setting up an exhibit is a real task, and the expense of rentals, help, etc., may not appear to be justified. However, the automobile dealers and others who compete with us for what money is in circulation are generally represented at these exhibitions, so it is up to us to do our bit to keep the public electrically-minded. An exhibit should be the product of careful planning in order to attract and interest the people in attendance, and to create desires in their minds for our electrical apparatus.

Other mediums of advertising include bill-boards, street car cards, hand-bills, direct mail communications, etc. Bill-boards are hardly feasible for any but the largest municipalities, and even they might find it expensive to prepare the necessary sheets, etc. By co-operating with manufacturers you might secure local bill-board displays of electrical appliances and so remind your consumers of electric service while they are on the streets. Painted signs would appear to be more adaptable for Hydro advertising, and when lighted properly they will demonstrate their effectiveness to other advertisers. Direct mail advertising to those who are prospects for certain appliances would appear to be part of a successful Hydro Shop programme. For all Hydro Systems, whether merchandising or not, it would be good business to include a piece of electrical literature with every bill that is mailed out. Stuffers are supplied by many manufacturers for the asking and may be used to advantage in their proper seasons. The Bell Telephone Company and the Consumers' Gas Company send out a specially prepared pamphlet with every bill. Many United States utilities do the same in order to supply their consumers with information on the latest electrical appliances and how to use them.

At one time our own Hydro-Electric Power Commission turned out a very successful monthly leaflet called, "The Hydro Lamp," which was distributed at cost to the Hydro municipalities. Such a news-sheet ties in with newspaper and display advertising by providing detailed information that is too lengthy for newspaper advertisements and too intricate to explain in a window display. A pamphlet like this may be made sufficiently attractive and interesting that it will be welcomed in every home and will enjoy the special advantage of receiving the reader's attention in a moment of leisure. Moreover, such a leaflet would

be useful for acquainting the younger generation with their Hydro and its achievements. Whatever mediums and methods of advertising we use, we must present our message frequently and effectively if we are to hold our own in the present competition for markets, a competition that has assumed high pressure proportions of late years with the introduction of radio advertising.

What to Advertise

Under this heading is a list of services which are required in the average home, and which might be advertised consistently by each Hydro Utility wishing to increase its consumption per domestic consumer:—

(1) Better Light—Better Sight.

(2) Electric Cooking.

(3) Electric Water Heating.

(4) Electric Refrigeration.

(5) Miscellaneous Electrical Appliances.

(6) Adequate Wiring.

To the ordinary householder these services are more or less desirable and are regarded in much the same category as automobiles, home furnishings, vacation trips, life insurance, etc. The amount of money available for expenditures of this nature generally is limited, and consequently will restrict such purchases to only the most desirable item. Dealers in all kinds of commodities are working on our consumers with various forms of advertising, and included in these are electrical dealers anxious to sell electrical appliances. If we help out our co-operating electrical dealers with advertising that will create stronger desires in the minds of our consumers for electrical conveniences, we are endeavouring to gain new loads in the homes of our consumers. The matter of Hydro Shop merchandising need not in any way affect the appeal for bigger and better efforts to popularize electric service in our homes.

While the foregoing is aimed directly at increasing the use of electric service, there is another type of advertising that acts indirectly and is called "good-will" advertising. Some public utility concerns, notably the Bell Telephone Company, feature the efforts of their staffs to maintain service twenty-four hours a day, regardless of storms and other conditions that tend to interrupt continuous service; or they depict the efforts of their laboratory research staff to produce improved equipment for making their product the best obtainable. Some of this advertising is very interesting to practical-minded folk, and must enhance public opinion considerably in favour of the commodity advertised. Our own H.E.P.C. ran a few of these advertisements about two years ago, as some of you will recall. The result of good-will advertising is possibly more intangible than direct advertising, but without a doubt it should inspire confidence in our service, our rate structure and our administration.

Other opportunities arise occasionally for indulging in "good-will" advertising, as for instance the installation of new station equipment, new feeder lines, or new rates. These things are of interest to our consumer-owners, and are likely to increase the prestige of our Hydro Utility. Some municipal systems go to the expense of inserting a notice in the local news-

paper to explain the cause of major interruptions to service in order to acquaint their consumers with the difficulties that are encountered in trying to maintain twenty-four hour service. It is felt, also, that publicity might well be given certain accident prevention information, particularly to the children through our schools and school books.

From the above you will note that there are many things to advertise in order to educate the people throughout the Province to the point where they will want electric service in abundant quantities for operating their homes and their businesses. It surely is a worthwhile objective, therefore, to tell our consumers about the many advantages of electric service they may secure from a system they own, at costs which will tend to go down as the consumptions go up.

The Make-up of an Advertisement

From an intimate acquaintanceship with many Managers of Hydro Systems, I am convinced that a lot of them would be glad to do a larger amount of advertising for their Utilities if they were more familiar with the task. They do not object to the expenditure for newspaper space, but appear to look upon the writing of an advertisement as a rather "sissy" job, and keep putting it off when they realize very well that some action in regard to advertising should be taken. As proof of this statement I would point out that in municipalities where assistants are available to write advertising, it generally is written and used.

It has been said that a letter should be written just as clearly and as simply as you would talk to the person if he were sitting beside you. Using the same kind of illustration, a newspaper advertisement is like a message that you would shout to another person as he is passing your window. The shout must be loud enough to attract the person's attention, and the message must be short in order to be grasped within the brief space of time he is passing you. In addition, your words must be well chosen in order to convey the idea you wish him to get, and your message must carry persuasion so that he will act as you request him to without further shouting; you have only one shout.

If you will picture yourself looking over the newspaper, you will recall that, although you scan the entire page, you do not notice all the advertisements, but only those which literally shout at you. These advertisements which attract you, therefore, have a heading or picture that catches your eye. Sometimes you merely hesitate at such an advertisement and then travel on because there is nothing to interest you beyond the initial attraction. But if the first line of the advertisement proves interesting you will read on down the body of the advertisement, which is exactly why the advertiser pays for the space to run the picture or the extra large head-line. The fact that the advertisement is interesting you sufficiently to read all of it is of no consequence, however, unless it creates in your mind a de-

sire for the product about which you have been reading. And although the advertisement may be successful up to this stage, it may fail to do its work if it only creates a desire in your mind and does not bring you to the point where you will buy the article advertised, or send for the sample offered, as the case may be. A successful advertisement, therefore, is one that attracts your attention, arouses your interest in the product, creates a desire in your mind for the article, and induces you to take some action towards acquiring the thing advertised. Sometimes, of course, a whole series of advertisements are necessary to do all this, as detailed explanations may be too voluminous to retain the reader's interest throughout one advertisement. But in a well planned series of advertisements the psychology is the same—to make the most sales at the least expense. For our purpose we wish to tell the readers about electrical appliances so that they will devote a part of their budget to electrical goods.

In writing up an advertisement, therefore, the first thing to do is to determine what article, or articles, we wish to feature in the advertisement, bearing in mind that one subject, such as cooking or lighting, generally is entirely sufficient for one advertisement. Next, the electros of pictures that may be used should be looked over and the file of any previous advertisements on the subject reviewed. A little quiet reflection will evolve various plans and suggestions which we may sketch roughly on paper to see how it looks. From these notes the advertisement may be developed, featuring the ideas that should be incorporated into our message, and keeping in mind the requirements of a successful advertisement as mentioned above.

The heading or the picture, or both, must serve the purpose of catching the eye of the reader and holding it an instant, during which his mind will become interested in the message "shouted" by the large type. For instance, the heading "Free Wiring", is likely to attract the average person's attention because of its unusual character, and it will arouse his curiosity to read further and find out about the free wiring. A picture of an electric range will especially attract a woman's attention, possibly to compare the range in the picture with her range or the range she would like to have. So we have the beginning of an electric range advertisement, as many have begun in various Ontario newspapers this last two months. Other headings could be substituted for the above, such as "Hydro will help you", "$20.00 Bonus Offered", or "A Dream Come True". Scores of headings may be made up, each one short, catchy, and designed to interest the reader so that she will read further into the smaller print. Speaking of attention-getters, an advertising authority recently stated that the three most successful subjects to use for this purpose were "girls", "dogs" and "children", which appears to be con-

firmed by a large portion of advertising in circulation.

Having induced the reader to look at our advertisement, we must now proceed to give her some vital reasons for reading further. Frequently a sub-heading is used for this purpose with medium sized type, explaining further, "Hydro now installing a three-wire service from pole to electric range at no charge," or "Buying an electric range is now made easier, as Hydro will pay for all wiring". Then, in smaller type will come a few details stating very briefly that a special campaign is under way to sell electric ranges, that the offer of free wiring applies to a new range that may be purchased from any electrical dealer, and that time payments may be arranged, etc. Other sub-headings of important details may be inserted down the advertisement so as to avoid any more than a few lines of small type at a time. If the reader hasn't an electric range, this information should be of interest to her, but it must be brief. It is a mistake to attempt the description of such details as elements, switches, insulation, thermometers, and fuses all in one advertisement, because very few people would read it or scan further down the advertisement.

With the reader's interest aroused, we now should try to create a desire on her part for an electric range, and of course to continue her interest in the advertisement as she reads on. This is where we must stress the facts that an electric range is so handy, always ready for use at the turn of a switch, or that it is safe, quick and clean; or the features of better cooking, increased leisure, dependable performance, etc., may be emphasized. Some of these points are sufficiently important to rank as sub-headings in large type, so that the advertisement will present a complete message whether it is read thoroughly or browsed over hurriedly. If a series of range advertisements are to be run, it would be well to stress only one point or appeal at a time, in our efforts to create a desire for electric cooking. A single appeal, of course, may be presented from different angles, so as to completely cover this phase of electric cooking. For instance, in featuring cleanliness, the various points of this appeal may be cited — clean utensils, clean walls, clean curtains, clean hands, etc. Too many outstanding advantages of anything are confusing to the reader and possibly a reflection on her mentality for not having owned such an article before now.

In presenting reasons for our reader to buy an electric range, or to install better lighting, we should try to make it very easy for her to change her mind from the indifference or opposition she has entertained in the past, to a desire to benefit by electric cooking or improved lighting. All our tact may be used to advantage in writing the advertisement, as we are endeavouring in a few words to bring other people to our viewpoint. As an example, the statement "To keep cool in summer you should cook with an electric

range," might be resented by some readers; whereas the same thing expressed, "To keep cool in summer, wouldn't you like to cook with an electric range?" will sound less harsh and will be more likely to receive the reader's assent.

As an aid to creating a desire for an article, pictures may be made to play an important role, because they give details that are much too lengthy and tiring to read. Accordingly a picture might serve the dual purpose of attracting the reader's attention and of showing details pertaining to the article advertised. A picture showing a housewife taking a pan of perfectly cooked biscuits from the oven, catches the eye of a reader and tends to prove that an electric range will produce perfect biscuits. A measure of proof, therefore, is another strong point to use in trying to create a desire for our product.

The success or failure of an advertisement, however, is dependent upon whether or not a reader takes any action to buy the article advertised, or to indicate that he or she is interested. It will be appreciated, of course, that electrical appliances which run into considerable money will not be purchased as a result of one advertisement or one demonstration. Electric ranges, refrigerators, etc., generally are sold long before the sale is made. In other words it is missionary work done in advance that has sold the idea, but could not complete the sale for various reasons, such as lack of money, or possibly just lack of attention by a salesman to close the deal. Accordingly, the wording of an advertisement should make it easy for all who are interested to take some action towards acquiring the article, or to make known the fact that they would like to receive further information about the matter. Frequently the suggestion is made that the reader telephone the office for a demonstration or free trial within a certain time, so as to get in on special inducements of price or service. If, as a Hydro Utility, you are doing general advertising, your only course might be to add—"Call on your electrical dealer for special terms, etc." The suggestion of definite action, therefore, is of vital importance to the success of an advertisement, and justifies a careful selection of words to urge immediate purchase or request for information.

At the present time we are using the slogan, "Hydro is yours, use it", so that it would seem only proper to suggest that all Hydro advertising might use this slogan and tie in with Hydro advertisements throughout the Province.

In making up an advertisement for the newspaper, it is generally possible to have the assistance of the newspaper advertising man to help you with the make-up. Some of these chaps are experts in their line and may be depended upon to make a real good advertisement out of a brief description about the article you wish to advertise. So do not hesitate to call upon your newspaper man. He might talk the printer's language of lines, half-tones, bold

type, etc., the same as you would about horsepower, kilowatt-hours and lumens, but he will understand our dimensional units of inches and dollars, and will give you what you want.

A few hints in regard to writing advertisements may be submitted here: Position in the newspaper is important; so try to secure a position adjacent to reading matter so that it will be easily noticed, even though this might cost a little extra. Use simple concise language, and select your words carefully, as the object is to convey an idea rather than to impress your readers with the technique of composition. Superlatives are not as effective as reasoning and proofs. Make the advertisement easy to read. Make your appeals as graphic as possible, e.g., a simple statement in an advertisement that, "An electric range cooks meats better than other types of ranges, because it retains the juices, etc." may be quite true, but will not leave the same favourable impression as, "With an electric range you will be able to take your meat out of the oven, knowing that you still have all the juices, etc." In this way the imagination of a person is encouraged to ponder on the actual experience of cooking and serving a delicious roast of meat to her family and friends. Appeals may be made to such qualities as—pride of ownership, pleasure, profit, but go easy in appealing to the quality of fear, which may have a disturbing effect on the reader's confidence in the entire list of electrical appliances. The length of an advertisement depends upon the interest you can put into it, and will not leave room for preliminary sentences that do not mean any more than an introduction to the message you wish to get across; in effect begin at the most interesting statement you can make up. Attractiveness of an advertisement will depend largely upon the counter attractions of other advertisements; this means that your advertisement must receive your careful planning in order to be successful. Large advertisements tend to give the impression of strength and substantial backing, while frequent advertisements make for better acquaintance; a judicious assortment throughout the year will be easier to make up and of more interest to your readers. Statistics claim that 90 per cent. of the purchasing is done by women, so keep in mind the fact that appliance advertisements must appeal largely to the woman of the home. If you advertise electric ranges, be sure that you have them in stock and that your employees know about the prices and terms. In the demonstration of appliances on the floor of the office, it is very important that all the staff who might by any chance have to put on a demonstration are familiar with the work; many demonstrations occur with prospects who actually are interested and may fall flat if not given thoroughly and correctly.

A few "don'ts" may be suggested as follows:—don't exaggerate or you will lose the confidence of your consumers; one successful advertiser

has said that a good advertisement must make sales for today and friends for tomorrow. Don't knock your competitors, it will be resented by many readers; use all the stress you care to in pointing out the advantageous features of the product you are advertising. Don't expect people to take an interest in your advertisement if you use familiar old phrases that have been worn threadbare many years ago, such as, "The best in the world", or "The biggest bargain ever offered".

A most essential factor in an advertising programme is to plan your advertisements in keeping with the seasons. This means simply a schedule drawn up a few months in advance, listing the months or weeks and the topics that should be featured each week, such as refrigerators and ranges in the spring months, vacuum cleaners in house-cleaning periods, and better lighting in fall and winter months. In between times you may run advertisements on washers, ironers and appliances that are sold more or less uniformly throughout the year, including to some extent even ranges and better lighting. Such a schedule of advertising, I have found very handy when a newspaper has telephoned that their copy of the next advertisement is required in twenty or thirty minutes' time. To be caught without a copy of your advertisement prepared, however, is something that might easily happen where the Hydro manager must give his personal attention to all the innumerable details in connection with the operation of his system, line-work, collections, correspondence, etc.

The make-up of an advertisement therefore is merely the unfolding of our story about electric service, just as we would like to tell it to our consumers if we had the time and opportunity to call on each one. The difference, of course, lies in the fact that we are restricted by time and space, so must word our messages with high intensities of interest and appeal. In any event, whether we are putting on a window display, a practical demonstration, or an advertisement, the essentials of advertising must be satisfied in some measure—attention, interest, desire, and action. Your enthusiasm about Hydro service, together with a little time and effort, will enable you to turn out creditable advertising, but the most essential of the essentials is *action.*

How Extensively to Advertise

A determination of the proper amount which a Hydro Utility should spend on advertising calls for the serious consideration of each Commission and its management. A common figure for retail and departmental stores to use for advertising is from 2 per cent. to 5 per cent. of their sales, although certain concerns exceed this limit and spend as high as 10 per cent., because they find that it pays to advertise on a bigger scale. The National Cash Register Company makes the statement that for each concern which fails because of too much advertising expense, there are sixty that fail

because of too little advertising. Like many of our expenditures, however, the percentage that we must spend to secure a certain result will depend to a large extent upon the efficiency with which we spend it. In other words, we can waste a lot of money on inefficient advertising.

How often a Hydro System should advertise in a local newspaper, of course, is closely related to the amount of money that is allocated for its advertising purposes. As a suggestion, I would say that in a municipality having a daily paper, an advertisement should be run each week, and if a weekly newspaper, at least every second week. The day of the week that will suit the larger daily papers is liable to be Saturday in the winter months and Monday or Thursday in the summer months, because week-end trips in the summer time reduce the attention given Saturday newspapers. Where there are two newspapers of different political affiliations it likely will be advisable to use both papers. For the smaller municipalities with no newspaper, the advertising will be left to displays in dealers' stores and possibly a bill-board if sufficient co-operation can be worked up with an appliance manufacturer using a poster service. Stuffers with the bills will help to keep the consumers posted on electrical matters, and might be read quite thoroughly. I would recommend that no more than two stuffers be included with a lighting account.

Advertising is a commodity sometimes regarded only as a necessary evil, and purchased with no more care than is exercised in buying a ticket on the Irish sweepstakes. I honestly believe, however, that there is much more scope for economy by intelligently using your advertising allowance than there is in the purchase of overhead construction supplies, the price of which is more or less standard. In the first place, I would not think of accepting any advertising copy as satisfactory unless it would meet with the requirements outlined in the preceding section of this paper, and in addition, possess a real appeal to others of my staff. The opinions of different people are frequently of much value in criticizing the make-up of an advertisement, because after all it is intended for the attention of others; the general public are the real critics and also the final judges. If you are advertising now and are not satisfied with the results you secure from your advertisements, you might do well to consult a firm of advertising specialists, of which there are many in Ontario.

Whether or not advertising pays, and the methods of testing the effects of advertising, can be worked out for large scale advertising on the basis of the number of sales per advertisement insertion. In smaller communities the merchants do not look for statistical proof that their advertisements are "pulling" or falling down. They know by the demands for their advertised articles just how successful their advertising has been; moreover, many of them advertise partly to keep their

names before the public. Conclusions as to the success of your advertising cannot be drawn immediately as considerable time and repetition might be necessary to synchronize the "creating of the desire" for an appliance and the "financial ability to take the necessary action". We may rest assured, however, that our competitors will not let up in their advertising as long as sales are possible, so we must make similar efforts to protect our industry, or watch it fall behind, and thereby forfeit our chances to have the lowest possible cost per kilowatt-hour.

In the consideration of an advertising programme, our attention might well be given to the use of a suitable electric sign for the Hydro office. This idea of displaying a sign in front of a place of business, by the way, is the oldest form of advertising known, and has come down from the early Babylonian days when merchandising was in its infancy. This form of advertising is still considered favourably by most concerns selling merchandise, and should be sponsored by us in a very practical way. In many towns and cities in the United States, I have noticed an imposing electric sign in front of the Electric Utilities office, and believe that some of our Hydro offices have overlooked this opportunity to give leadership in the use of electric signs. So, how about looking over our Hydro offices when we get back from this convention, and asking ourselves if we are equipped with an electric sign which will demonstrate suitably to our community the fitness of this form of advertising? Electric signs have light, colour and motion, and contribute tangibly towards making our people electrically-minded.

Dividends From Advertising

One effect to be expected from an aggressive advertising programme is a stimulus to the efforts with which our employees will contact our consumers. It is human nature for a person to follow the example of those in authority, and if the example is inclined to be one of inaction towards securing new business, it is almost certain to be reflected in an indifference on the part of the staff towards securing the maximum of new business. But when the office is alive with floor demonstrations, window displays and active newspaper advertising, you may be sure that your employees will be on their toes to accomplish the desired objective—new load.

As an illustration of such a result, I recently heard of a street railway company that changed its management and appeared to benefit from the change. Under the former manager, each street car had a sign hanging in a conspicuous position, stating that the company would appreciate it very much if the patrons would report all cases of incivility and discourtesy on the part of its employees. The new manager gave the men a talk on dealing with the public and hung notices in the cars stating that each employee had been selected for his position because of his ability to serve the pub-

lic with tact and courtesy, and that they would especially endeavour to help strangers find their way about the city. The street railway company is reported to have gained immensely from the leadership of the new manager, the new signs on the cars, and the stimulation given the men to create better relations with their patrons. So we can safely expect more aggressive sales effort on the part of our employees, if we start at the top in a determined effort to secure more business.

A second dividend that may go with increased newspaper advertising is the publicity which the press will give to news of electrical progress from time to time. Editors of the smaller newspapers receive great quantities of information concerning commodities of all kinds which they are asked to use in their papers as "news items". They will be only human if they give space to those items which will tend to please and help their advertisers and supporters. Not only might favourable publicity be gained by a Hydro Utility as a regular advertiser, but unfavourable comment at times may be kept to a minimum without interfering with the newspaper's duty to its public, that it publish the truth at all times. The backing of the press at times of severe service difficulties may make your life a little more enjoyable.

It is from our consumers, however, that we expect our greatest dividend, as a result of a reasonable advertising programme. This advertising should describe to our consumers the greatest service that has ever been procurable, an electric servant in the home, on duty twenty-four hours each day, always working for increased comfort and health, and asking only 1 cent for doing the weekly wash, or from 5 cents to 10 cents per day for cooking the average family meals. If we sell our consumers plenty of this service, we will be able to use our lines and equipment to better advantage and thereby reduce the price per kilowatt-hour. Can other advertisers give the public as good value for their dollar? Their advertisements state that they can—in the form of new cars, house furnishings, various dependable watches and what-not. An era of intensive advertising has come upon us and is interesting our consumers in everything but electric service, if we remain silent. Let us, therefore, give Hydro service the publicity it deserves, so that our consumers will know what they may obtain in proper lighting, household appliances, electrical apparatus for industrial purposes, and how little it costs. With this information thoroughly distributed, we may rest assured that our industry will secure its proper share of the consumer's dollar.

In yet another way some electric utilities might expect to benefit from a programme of advertising, and I refer to a few Hydro Systems whose lack of publicity has caused many consumers to regard their Hydro only as the meter reader, the girl who takes their money at the office,

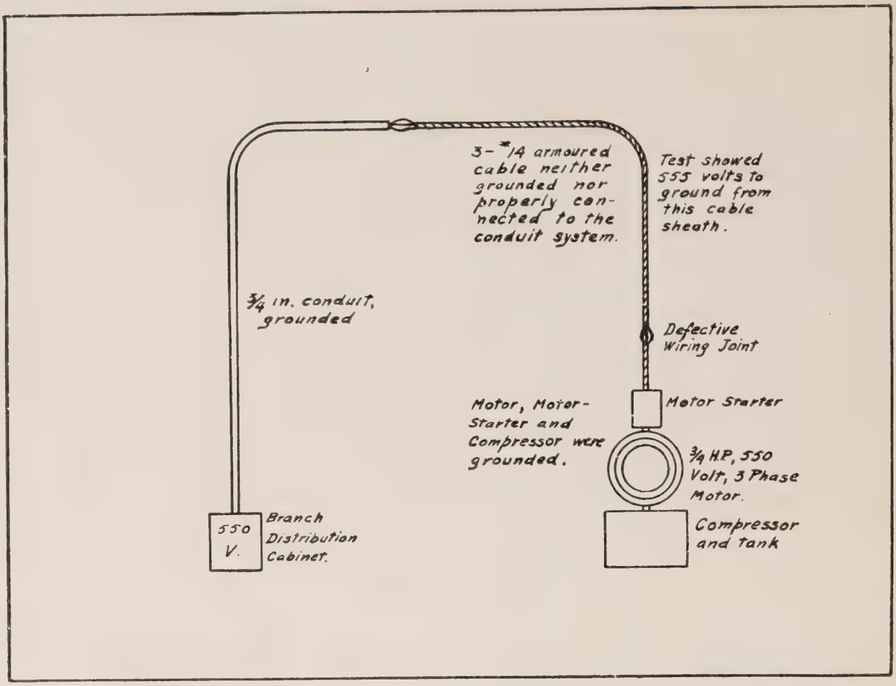
and the occasional unapproachable lineman who climbs poles or comes to the house to use the telephone. And it may happen that none of these three individuals do justice to their positions. A change of policy in such places, or even an improvement in certain municipalities whose conditions are not up to standard, whereby the office and the office window will become places of interest rather than recollections of unpleasantness, where the newspapers will talk friendly about all that Hydro service can do for people of average means, and where the employees are enthused with the idea of rendering real service to their consumers—well, such a change in policy cannot but raise the Hydro Utility to a higher plane in the estimation of the citizens of those municipalities. With that will come a better conception of the importance of Hydro to its consumers, and a greater respect for the management of such a utility. In the accomplishment of any such added prestige or dignity to your positions, Gentlemen, either as commissioners or as managers, you have nothing to lose and everything to gain.

Fatal Accident in Laundry

AN employee of a Toronto laundry was fatally injured by an electric shock on June 5th, 1936.

As indicated in the schematic diagram the laundry was equipped with a 550-volt motor-driven air compressor which at one time was installed in the boiler-room. It became necessary to change the location of the air compressor and this involved some re-wiring which was done by the deceased,—a man not trained for such work,—without securing a permit. This was of course a violation of the Hydro-Electric Power Commission's Rules and Regulations covering Electrical Installations.

An investigation of the accident showed that all non-current-carrying metal parts of the air compressor installation were grounded except the armour of a length of armoured cable which had been connected in the circuit to make an extension to the former circuit supplying the compressor in its original location. This piece of cable was found to be of insufficient length to reach to the new location and in making the necessary wiring splices at each end one of the live conductors of the cable had been left poorly insulated, with the result that it made metal to metal contact with the armour, thus rendering the armour of this section of the cable alive. This defect was not evident prior to the accident, due to the fact that the deceased had failed to ground the armour of this section of the cable, which resulted in an extremely hazardous situation as the floor of the room was cement and in a very wet condition. During the noon-hour the



deceased had occasion to stand on the motor, which was grounded, and on reaching up and coming into contact with the ungrounded, but accidentally alive, armour, he received a shock which proved fatal.

Such unfortunate accidents should serve as a warning that persons not instructed in proper methods of wiring should not be permitted to install or make alterations to wiring systems. If the alterations in this instance had been made by a skilled workman and inspected, as the law requires, by the Inspection Authorities, there is every reason to believe that the accident would not have happened.

New Horizons in Lighting

By Samuel G. Hibben, Director of Applied Lighting, Westinghouse Lamp Company, Bloomfield, N.J.

(Presented to Association of Municipal Electrical Utilities at Ottawa, July 3, 1936.)

CHARACTERISTIC of any period when the public consumption of standardized goods may show signs of stagnation, there is an increase in scientific research work directed towards the discovery or perfection of new and better devices. When such activity is superimposed upon the normal increase in knowledge and when further incited by the developments of our modern civilization, we should not be surprised to find new ways of doing our industrial or commercial jobs; better health; interesting improvements in all forms of human welfare,—new tools for doing the world's work of tomorrow.

This is particularly so in the discoveries and developments in the production and usage of light. The story of New Horizons in Lighting is so filled with romantic interest, and involves so many processes of living, that whether we are within or without the electrical industry we cannot fail to be thrilled by the recent records of the march of lighting progress.

If our story began coincidental with man's history, perhaps 300,000 years ago, we would note that for thousands of generations, in fact until about 3,000 years ago, the progress of civilization was exceedingly slow. Man is differentiated from the animals largely by reason of his control of fire and light. Man's civilization has advanced almost directly in step with his ability to make and use light or its companion radiations.

From the days of the Egyptian pottery lamps down through the ages to the time of the tallow candle some 300 years ago, we find very little to thrill us in the story of light sources. However, some 30 years ago there evolved the first really practical and efficient electric lamp employing tungsten wire and wherein the electrical energy was converted into luminous energy with a fair conservation of heat made possible by the blanketing effects of an inert gas within the glass bulb. As short a time as three years ago and largely within the past few months we observed a new family of lamps employing a distinctly new principle, namely, the ionization of a metallic vapor and the highly efficient production of light without the intermediate step of heat. At least these most recent illuminants, by reason of increased efficiencies, and perhaps to a greater degree by reason of different colors or qualities of radiation, bid fair to revolutionize our art and science of applied lighting.

The research scientist has long known of at least three fundamental ways of producing visible light. The oldest and most valuable method is of course the one of heating a black body

to incandescence, as the carbon particles in the open flame, or the tungsten wire in the electric lamp bulb. Less than a generation ago we could thus obtain from the electric lamp not over 5 lumens or units of light for each watt consumed. At the present time tungsten filament illuminants in household or commercial sizes may give us 15 or at best perhaps 20 lumens per watt. Our limit in this direction is the melting temperature of tungsten or of tungsten alloys slightly in excess of 3000 deg. cent., whereat we would expect to generate at least 40 lumens per watt. This may be the theoretical ceiling so far as quantitative output is concerned although other perfections, and other shapes and styles of hot wire illuminants still entice us on to further and continued efforts. Nor will there be any immediate likelihood that the tungsten filament lamp, expertly made and properly applied, will soon fail to carry the burden of lengthening man's day.

If all of our electrical energy could be converted to luminous energy throughout the entire spectrum we could expect to obtain in excess of 200 lumens per watt, and if all of our luminous energy could be concentrated into one color, the yellow-green to which the eye is most sensitive, we would expect to produce better than 400 lumens per watt. In consideration of the fact that some 10 per cent. only of our electrical energy can now be translated into luminous radiation, we can better realize that in spite of the remarkable progress of recent decades we yet have a long way to go before attaining a really efficient artificial sun.

Before we leave the filament lamp behind us let us not forget the millions of dollars of conscientious research and the tremendous accumulation of brains and energy that have given us a lamp, sturdy, serviceable, and convenient, purchasable for the price of a good cigar yet embodying in its makeup a series of perfections and refinements as accurate as the best time piece and as well balanced as the human machine. Just one item might serve to increase our appreciation of this device. If the tungsten filament in a well made lamp were to vary in diameter as much as the change in the human hair that takes place as between a dry day and a rainy day, the lamp would be hopelessly imperfect. The dimensional errors in a lamp filament must not exceed four one hundred thousandths of an inch and even the entire helical coil must often be no larger than the female hair or half the diameter of the male hair.

A second interesting but less familiar light source, partially exemplified by Nature's marine animals or the fire-fly, is chemi-luminescence or "cold light" such as may be demonstrated by mixing certain chemical solutions. This possesses only academic interest because in the hands of man it is very low in efficiency.

The third method intrigues us today because it is commercially possible to generate at least twice as much light for the same power and more especially because we now see the promise of a vastly greater variety of light quality. With these new tools and for the first time in man's history

we can superimpose qualitative lighting on top of quantitative lighting and thus attain the extra pleasures or achieve what I choose to call "mood conditioning". The invisible ultraviolet so freely emitted as a by-product of ionized mercury vapor can in its properties of fluorescence when impinging on the dyed fabrics or the interior finishings of tomorrow's residence gives us entire changes of scenes and the attainment of unbelievably beautiful bits of interior decoration. In the field of crime detection we note such examples as the comparisons of different materials, the identification of finger print markings, or the disclosure of erasures and forgeries. The use of black light extends to the analysis of mineral ores, of healthy teeth, of adulterated food products and a host of manufacturing aides. Still shorter ultraviolet radiations as produced by recently developed vapor lamps make it possible to materially aid medicine and surgery, or sterilize foods and liquids against bacteria and fungi. Involved in these new lighting tools we see the extension of fluorescence to the production of new luminous ornaments and decorative types of lamps, beautiful not only in color but much higher in efficiency than previous lamps.

In agriculture we must acknowledge that much can still be done in the control of plant diseases by radiation or in the luring and trapping of objectionable insects. Soil heating, sterilization, and perhaps even developments of new species of plants and flowers seem possible under the influence of peculiar wave lengths of visible and invisible light.

Still other forms of vapor lamps as employing sodium, possess an interest in the job of highway lighting in the increased safety of vehicular traffic. By capturing bits of rare atmospheric gases and from studies of the aurora borealis, we find in our hands an almost magical assortment of lamps that are caused to glow by merely introducing them into the presence of an electric field. In still other forms we are learning how super-high pressures of metallic vapors are capable of radiating nearly a continuous spectrum as well as a broken line spectrum, and today in the research laboratory it is not unusual to find quartz capsules the size of a peanut which are producing 75 lumens per watt.

Tomorrow's lighting job may need new tools but when viewing the rapid progress of recent months we shall not hesitate to predict that the expanding horizons of lighting will find us in possession of an ample assortment of new lamps, each capable of giving us a peculiarly characteristic color or wave length or volume of radiant energy. Thus one need not fear as to the future of the lighting business. Nevertheless, these developments imply the need of the highest possible talent in the proper utilization of these new tools. The electrical industry and the lighting fraternity consequently acknowledge a sobering responsibility, for mankind moves forward and upward in lock-step with light.

Arc Welding Electrodes

By W. D. Walcott,
Inspecting Engineer, H.E.P.C. Laboratories

DURING the last decade numerous advances have been made in the art of welding which have resulted in a great improvement in the quality of welds. These advances may be divided into three main classes:

1. Improvements in welding technique.

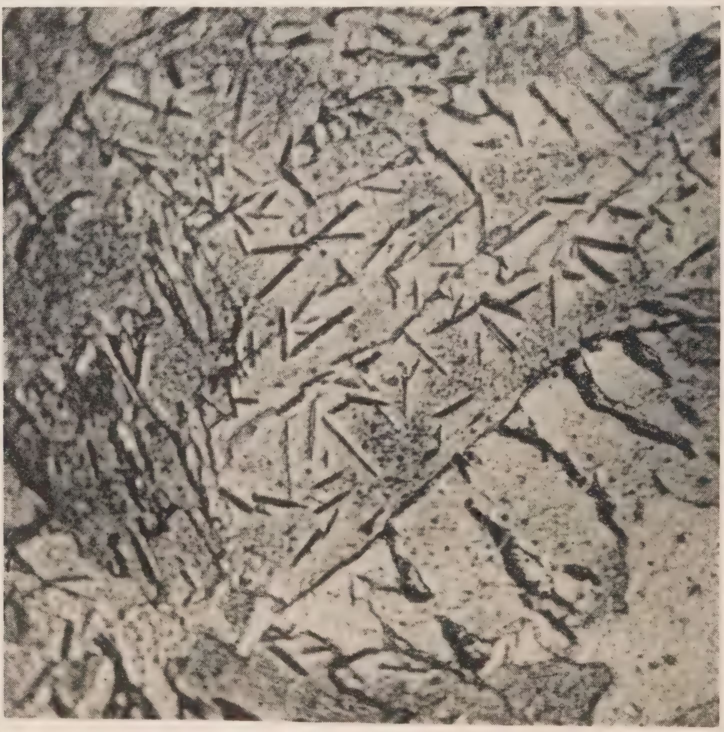
2. Improvements in the characteristics of welding machines.

3. Improvements in the quality of electrodes.

It would be difficult to estimate the relative importance of these advances as they are inter-related, in that the only method of obtaining good welds is to employ operators who are applying correct technique, with current supplied by an efficient welding machine, using electrodes of the best quality.

The question has often been asked: "What constitutes a good weld?" A good weld may be defined as one which is free from flaws, imperfections, from high residual stress; and possesses approximately the same physical characteristics as the "parent metal".

We will now consider some of the



Nitride needles. (Magnification 645).

Typical structure of shielded arc weld.
NOTE:—*Refinement of grain and homogenity of weld.*
(Magnification 100)

more important characteristics of the "parent metal" which is usually a mild steel with a carbon content of not more than about .35 per cent.

Reference to the Specifications of the American Society for Testing Materials gives the following information under the heading "List of Specifications for Steel Suitable for Fusion Welding":

"In preparing this list of specifications, the Committee is mindful of the fact that welding technique is of fundamental importance. While the lower carbon steels are naturally easier to weld, other factors being equal, steels up to .35 per cent. carbon have been welded with satisfactory results under the usual commercial practice."

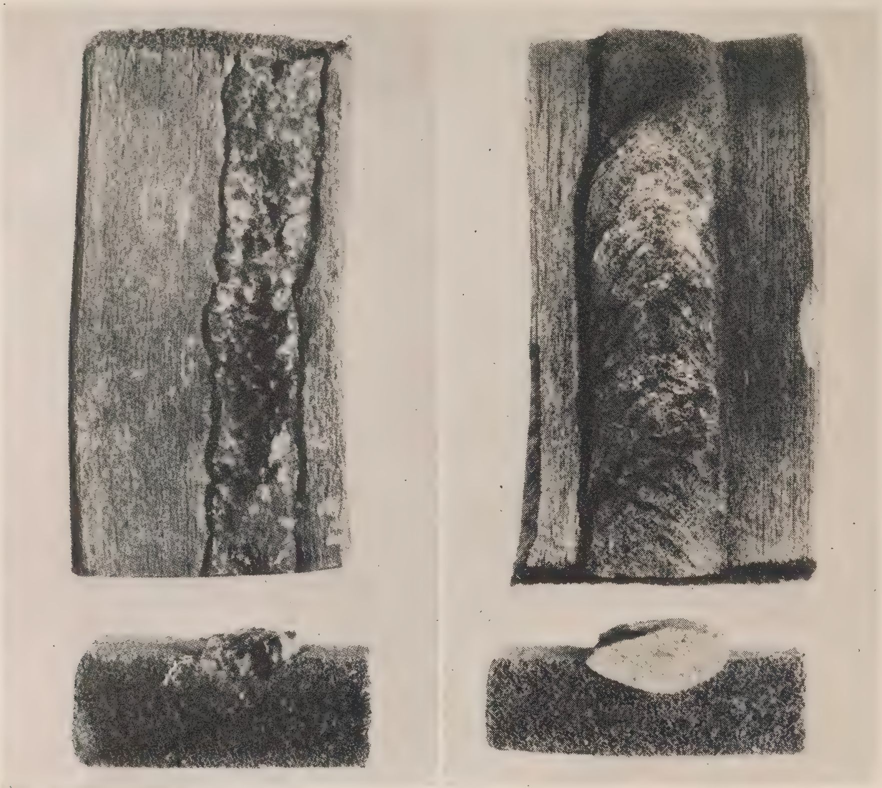
A list of twenty-one specifications is given in the Specification for various grades of steel including structural steel, boiler and fire box steel, and steel piping all with a carbon content of not more than .35 per cent.

The following is the range of the more important physical characteristics of steels included in this class.

Ultimate strength ....50,000-60,000 lbs. per sq. in.

Yield point ....24,000-30,000 lbs. per sq. in.

Elongation, per cent. in 8 in. ....25-30 per cent.



Resistance to corrosion of bare arc welds (left) and shielded arc welds (right). Specimens were immersed in a 50 per cent. solution of hydrochloric acid and boiled for one hour.

Let us study briefly the types of ferrous electrodes on the market. The electrodes commonly used may be divided into two main classes:

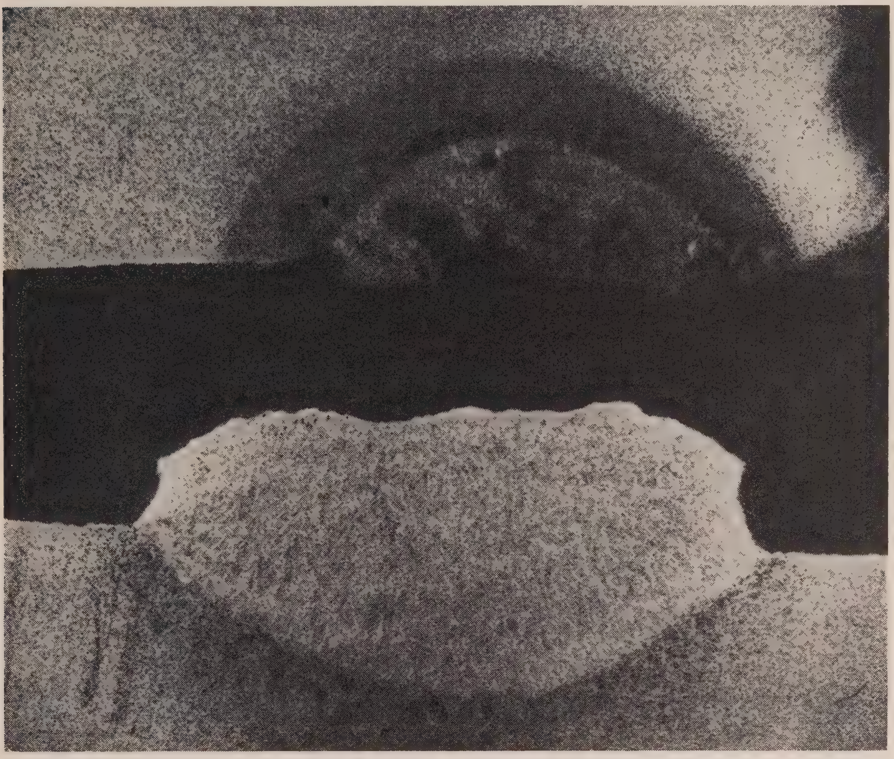
1. Bare Electrodes, which include lightly covered or wash electrodes.

2. Covered Electrodes, which include heavily covered electrodes.

These different types of electrodes produce welds of entirely different physical qualities and the reasons for these differences can be easily understood by a brief study of elementary metallurgy. Steel in the molten state has great affinity for oxygen and nitrogen, and when it is exposed to the air it enters into chemical combination with the elements of oxygen and nitrogen with the result that oxides and nitrides are formed in the steel. In a weld, oxides take the form of scale and are observed as minute black particles which may sometimes be recognized by the naked eye. Nitrides are long, thin, needle-shaped crystals which are visible at magnifications of about 600 diameters.

BARE ELECTRODES

With the use of bare electrodes, the molten globules that pass from the electrode to the parent metal, are exposed to the surrounding atmosphere



Micrograph of bare and covered rod weld after treatment in acid. NOTE:—*The oxides in the bare rod weld shown on the upper half of the picture. (Magnification 8)*

which is comprised chiefly of oxygen and nitrogen. The molten parent metal is also exposed to these elements. They combine with the molten metal and form oxides and nitrides in the weld metal, with the result that we get a weld which might be described as a low grade cast steel. It is low in ultimate tensile strength and yield point, ductility, impact value, specific gravity; and gives poor resistance to corrosion. In fact, we have a product which is inferior in physical characteristics to the "parent metal".

COVERED ELECTRODES

In order to protect the weld metal from the injurious chemical combinations with the oxygen and nitrogen of the air, recourse was taken by the manufacturers to shielding the arc.

The arc can be successfully shielded in two ways:

First, the protection may be provided by means of a slag of low specific gravity, low surface tension, and low thermal conductivity which forms as the coating or covering of the electrode melts. It surrounds the particles of molten metal and protects them from the air as they pass across the arc stream and then forms a protective and annealing covering over the weld.

Second, the protection may be pro-

vided by completely enveloping the arc with an inert gas which will not enter into chemical combination with the molten metal and yet at the same time will prevent its contact with atmospheric oxygen and nitrogen.

The result is the welds that are made with the shielded arc process by either of these methods, are comparatively free from oxides and nitrides and are therefore comprised of metal having superior physical characteristics to those deposited by a bare wire electrode. Welds made by this process show greater ultimate tensile strength, higher yield point, greater ductility, lower residual stresses, higher impact value, and better resistance to corrosion and higher specific gravity than welds made with bare electrodes.

The following table will give the comparative results of physical properties obtained from tests made on mild steel, bare electrode weld metal and covered electrode weld metal:

	Mild Rolled Steel	Bare or Washed Electrode Weld Metal	Covered Electrode Weld Metal
Ultimate Tensile Strength, lb. per sq. in.	55,000-65,000	40,000-50,000	65,000-85,000
Yield Point, lb. per sq. in.	30,000-35,000	30,000-32,000	50,000-55,000
Elongation, per cent. in 2 inches	22-30	5-10	20-30
Reduction in Area, per cent.	30-50	2-5	35-50
Impact Value, Charpy, ft. lbs.	26-30	5-13	30-35
Impact Value, ft. lbs.	40-80	8-15	45-80
Endurance Limit, 10,000,000 reversals without failure, lb. per sq. in.	26,000-28,000	12,000-16,000	28,000-30,000
Average range of locked up residual stresses, lb. per sq. in.	....	10,000-35,000	Slag shielded: 3,000- 6,000 Gas shielded: 8,000-25,000
Resistance to Corrosion	Fair	Poor	Good
Specific Gravity	....	7.5-7.7	7.82-7.86

Welds made with bare electrodes on water-tight or oil tight pressure vessels have developed leaks after years of service. One explanation of these failures may be that in time there is a deterioration in the weld caused by the presence of oxides. This deterioration appears to be due to porosity. The lower specific gravity of the deposited weld metal is a clue to this explanation.

Failures have sometimes occurred in bare electrode welds from residual stresses which have been aggravated in service, and which have stressed the metal above its ultimate strength. Sub-zero temperatures, on equipment which is exposed to the elements, will have this effect. Weld metal deposited

by the use of the shielded arc process is not so subject to these failures on account of its greater strength and higher ductility.

CONCLUSION

The last three or four years have seen a decided swing to the use of the shielded arc on this continent. In European countries, with the exception of Germany, covered electrodes have been in vogue for many years. There is no question of their superiority over the bare electrode and the extra cost is outweighed by the advantages derived from their use.

Third World Power Conference

THE Third World Power Conference will be held at Washington, D.C., on September 7th to 12th, 1936. Concurrently therewith there will be the Second Congress of the International Commission on Large Dams of the World Power Conference.

The World Power Conference is a federation of national committees and representatives of some 50 countries organized in 1924 upon the initiative of the late D. N. Dunlop of Great Britain.

The purpose of the World Power Conference is to consider how the sources of heat and power may be adjusted nationally and internationally:

By considering the potential resources of each country, in hydroelectric power, coal, oil and other fuels, and minerals.

By comparing experiences in the development of scientific agriculture, irrigation, and transportation by land, air, and water.

By conferences of engineers, technical experts and fuel experts, and authorities on scientific and industrial research.

By consultations of the consumers of fuel and power and the manufacturers of the instruments of production of power.

By conferences on technical education to review the educational methods in different countries, and to consider means by which the existing facilities may be improved.

By discussion on the financial and economic aspects of industry, nationally and internationally.

By conferences on the possibility of establishing a permanent World Bureau for the collection of data, the preparation of inventories of the world's resources, and the exchange of industrial and scientific information through appointed representatives in the various countries.

The International Commission on Large Dams of the World Power Conference was established in 1930 on the initiative of the French National Committee to deal with certain special technical problems. It holds its meetings at the same time and place as sectional or plenary meetings of the

World Power Conference and as integral sessions of such meetings.

The program prepared for the Third World Power Conference differs materially from previous ones, particularly from those of recent years. So much stress has heretofore been placed upon the purely technical side of power development and so large a part of the several programs has been devoted to this one phase of the subject that it seems desirable to change the emphasis at the Third World Power Conference and to devote its discussions to the more fundamental, and in many respects more important, problems of the relations of power resources, their development and use to the social and economic interests of the nation. For this reason the American National Committee with the approval of the International Executive Council has selected as a subject for the meeting "The National Power Economy" considered in its broadest sense of energy sources, development, and utilization, and it proposes the discussion of:

> Its physical and statistical basis; its technical, economic, and social trends; the relation thereto of the fuel-producing, processing and distribution industries and of electric and gas utilities; practices and policies respecting organization, control, and public regulation; national and regional planning of power development and use; conservation of fuel and water resources; rationalization of the distribution of gas and electricity; and a national power and resources policy.

Following the General Sessions in Washington the foreign delegates and members will be taken on Study Tours to visit leading industrial centres, devoting their time to detailed technical discussion and observation. Tentative arrangements for the Study Tours by the American National Committee provide for a visit to Canada. The arrangements for the Canadian visit are being made by the Canadian Management Committee. On September 15th the delegates will arrive in Montreal as guests of the Province of Quebec and the Shawinigan Water and Power Company. They will visit electrical developments in Quebec, particularly the plants of the Shawinigan Company on the St. Maurice River. The following day will be spent at Ottawa when the party will be the guests of the Dominion Government. While here they will visit the electric power developments of the Gatineau Power Company on the Gatineau River. Leaving Ottawa that night, the delegates will travel to Niagara Falls, arriving on the morning of September 17th. Here they will be the guests of the Hydro-Electric Power Commission of Ontario, and spend the morning viewing Niagara Falls and inspecting the Commission's plants. After lunch at the Queen Victoria Niagara Falls Park Refectory, the delegates will continue their tour in the United States.

THE
BULLETIN

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Symposium of Range Campaign Activities

(Addresses to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Ottawa, July 3, 1936.)

By G. J. Mickler,
H.E.P.C. of Ontario

AS you are aware, the 1936 Hydro-Electric Range Campaign was launched officially on April 15th, 1936. Previous to that date considerable time was spent in preparing plans and advertising for this new activity. A meeting of the managers of the larger Hydro municipalities was called to consider plans which had been prepared. At this meeting the proposed newspaper advertising material was presented and criticized, also the show window and direct mail advertising material, and after discussing thoroughly the results of 1935 and the plans for the 1936 effort it was unanimously decided that a more intensive effort should be put into the sale of electric ranges this year than last, and that the tentative plans which had been submitted should be put into effect as far as possible.

RESULTS OF 1935 CAMPAIGN

In preparing the plans for 1936 the results and experiences of the 1935 range campaign were taken into account.

It was found:—

1. That electric ranges will not sell themselves; intensive selling effort must be exerted if any objective is to be reached.
2. Where the local Hydro System is aggressive there are more ranges sold than where only an indifferent interest to range sales is shown.
3. Where Hydro Shops operate, a still greater impetus is given to the sale of electric ranges.
4. Where the local utility finances the sales made by dealers, the dealers are more enthusiastic than ever before and a decided

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Vol. XXIII No. 8
AUGUST, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

improvement is observed in their attitude toward the Hydro.

5. Where the local utility partially or entirely relieves prospective consumers of the burden of a new 3-wire service, the sale of ranges increases.
6. If a local system is anxious to increase the sale of electric ranges it must take the leading part in promoting such sales, by constant advertising and other promotional effort, and must keep in touch with the dealers to see that their interest does not lag.

Taken as a whole, the 1935 Campaign was a decided success. We had over 100 municipalities actively engaged in advertising and selling electric ranges, and these municipalities served over 80 per cent. of the domestic consumers of the province, and when you consider that we started from scatch in most municipalities, with no local organization, no advertising and no provision for dealer co-operation, the number of electric ranges sold was indeed encouraging. From records which we have been able to secure over 7,000 electric ranges were installed by Hydro consumers from April 15th, 1935, to April 15th, 1936, and it must be remembered that, while our campaign started on April 15th, 1935, it really did not get started until well on into May or June in most co-operating municipalities.

Following the meeting above referred to a letter was transmitted to every Hydro municipality outlining the plans by which each could cooperate in the campaign, and suggesting a basis for determining local campaign policy.

Local Policy Recommended

Briefly stated, the following recommendations were made to all Hydro municipalities as a basis for determining the local policy:—

1. The sale of ranges made by the electrical dealers should be financed, if possible, over a period of from 1 to 5 years.
2. A financing rate should be established as low as possible, commensurate with the cost of funds and the terms offered by competing interests.
3. A 3-wire service and range wiring should be installed, if pos-

sible, at no cost to the consumer and considered as part of the local distributing system capital.

4. A quota of at least 10 per cent. of the number of electric ranges now in use in each municipality should be set as an objective for 1936 sales.
5. An advertising fund of $5.00 per range of this quota should be established for local promotional advertising.
6. A local advertising campaign should be carried on in co-operation with the dealers, either through the newspapers, by hand bills, billboards or in some other way, to keep Hydro customers informed that the campaign is under way, and to keep ever before them the policy which governs each local campaign.
7. Electric ranges should be displayed in every local Hydro office, if possible, or arrangements for outstanding displays in dealers' windows and stores, especially during the real range season—April 15th to July 15th.

H. E. P. C. Policy

To show that the Hydro-Electric Power Commission is actively behind the campaign the municipalities were advised that the Commission was making the following contributions to the range campaign:—

1. It is providing advertising material for local newspaper advertising, also window displays for dealers and pamphlets for general distribution.
2. It is providing the services of their advertising agents to municipalities to plan and place local newspaper advertising.
3. It is providing an advertising allowance of $3.00 for each new electric range of 50 ampere or over capacity sold by dealers to help them defer part of their advertising costs.
4. It is providing a sales manual for range salesmen.
5. It is providing a manual for municipalities which outlines in detail the plan for conducting a local campaign.
6. It is providing the services of representatives to help organize local campaigns.
7. It is taking part in a talking picture cooking school which was to be shown in over 150 theatres in the province.
8. It is displaying ranges in Hydro rural offices wherever possible or in local dealers' windows in towns where Hydro rural offices are located.
9. In the rural districts and urban municipalities operated by the Commission an allowance of $20.00 is being given on each new electric range of 60 ampere capacity or over purchased by H.E.P.C. customers.
10. New electric ranges, as above, may be financed for a period up to three years on the Hydro Thrift Plan, or up to five years on the Rural Loan Plan.
11. The financing charge on the Thrift Plan is 4 per cent. on the unpaid balance and 6 per cent. on the Rural Loan Plan.
12. Conducting an advertising campaign among Hydro customers to

inform them of our plan and supply them with information on electric cookery.

THE MANUFACTURERS' PLANS

Every range manufacturer has agreed to enlarge the scope of its Campaign activities. Some manufacturers are carrying on sales schools for dealers and salesmen; some are conducting numerous cooking schools, and most of them are carrying on extensive advertising campaigns in the newspapers, magazines and otherwise, and I believe that never, in the history of electric cooking in Ontario, has there been such an activity as there is at the present time to sell more electric ranges.

PROSPECTS

The prospects for range sales this year, according to the opinions of various authorities, are much brighter than they were last year. The manufacturers expect an increase of from 25 to 50 per cent. in their sales over 1935. Many Hydro municipalities expect, and are already realizing, an increase in installations over last year, and, with the campaign going on in our rural districts, we know that there will be a tremendous increase in the number of ranges installed by farmers and other rural customers.

RESULTS TO DATE—1936 CAMPAIGN

Each Hydro municipality, every manufacturer and manufacturers' salesmen, and others who may be interested, have been receiving copies of *The Hydro Ranger*, a bulletin published periodically to broadcast the progress of the Campaign and announce local policies and give out any other information which may be of interest to all concerned.

A study of the information contained in this bulletin reveals the fact that 99 Hydro municipalities have so far pledged their support to the Campaign in one way or another. Added to these municipalities are the 173 Rural Power Districts operated by the Commission, and in the above over 80 per cent. of the domestic users of Hydro are located, so it may be said that the Campaign covers 80 per cent. of the possible territory, and I am sure that if an opportunity were given to some of the other Hydro municipalities to learn the facts concerning the promotion of electric cooking and the advantages to be gained by the municipalities and by the Hydro system as a whole we would have a much larger number of municipalities and customers pushing electric cooking than we have at the present time. It is not possible to cover all of the ground in the short time that is available for organizing a campaign, and I believe that those municipalities who are not actively co-operating are missing an opportunity by not informing themselves and agreeing to take some part in this activity, be it ever so small. You will recall in an earlier paragraph we stated that where the local Hydro System does not take the initiative, the sale of electric ranges lags considerably, and conversely, if the Local System advertises, displays and even sells ranges there is a marked increase in the number of electric ranges sold.

It will be observed also that 27 municipalities are financing the sales of ranges made by dealers and them-

selves and that the term of years varies from 1 to 5 years and the rate of interest from no interest up to 6 per cent. In 54 municipalities 3-wire services are being installed free, or partly free, and in every municipality where ranges are sold by the local Hydro system an allowance of $10.00 or more is being made on old ranges.

CAMPAIGNING IN THE RURAL DISTRICTS

As announced in one of *The Hydro Rangers*, arrangements have been made for a display of electric ranges in every rural Hydro office where space will allow us to make a display, and already over 70 offices are showing one or more electric ranges. In some cases there are as many as 4 and 5 ranges of different types and makes on the floor. In arranging for this display the dealers in each municipality involved have been asked to co-operate by placing their ranges on our floor and augmenting our display with similar displays in their own show rooms, and the manufacturers have co-operated by making it possible for dealers and rural offices to secure these displays. We have plenty of evidence that the displays are responsible for a large number of sales which have already taken place. We know too that if there had been no displays there would have been considerably fewer ranges sold.

We did not expect when we started the campaign in the rural districts to be able to show any astonishing results, but up to date the sales have exceeded our expectations. Already over 105 applications for financing and bonus have been received, indicating that that number of ranges are being sold and installed, and in consulting with various Hydro rural superintendents there is evidence of at least as many more sales pending. When you consider the fact that our rural districts serve about 1/8th of the domestic customers of the province, and that the sales in Hydro municipalities and rural districts combined, since the 1st of May, are approximately 1,600 ranges, you can see that the rural districts are holding their own. It might be interesting too to learn that over half of the sales made to rural customers are cash sales, and the majority of ranges sell for well over $100.00.

* * * *

By J. E. B. Phelps, Sarnia Hydro-Electric System

We are operating in a municipality where we have gas competition—natural gas at a cost of 55 cents per thousand cubic feet, with 1,000 B.t.u. per cubic foot. Consequently, we have stiff opposition. They put in free services, pipe gas free from the meter to the gas range and we have to meet that kind of competition. We have endeavored to line up the contractor dealers and show them, prove to them the fact that we are operating a Hydro Shop and doing advertising and that we are building up their business as well as our own. We have them convinced of that fact and out of a population of some 18,000 I can report that we have about thirty per cent. saturation with electric ranges in spite of that competition.

We have lined up with the Range Campaign and we believe it is well worth while. Since April 15th, Sarnia Hydro has sold ten ranges. The two dealers have sold eleven. We have in-

stalled ten new services and the new load represented is thirteen. We put in free wiring to meet the competition of the gas companies; we put in free wiring right to the range. The customer comes in and says, "Here, you have put a service in for my neighbor and I paid for my service," and he has a complaint to make. We say, "All right, we will take over your old service and give you $15.00 for it." That keeps him satisfied.

We have distributed in the last three or four weeks, 3,000 of the pamphlet that Mr. Mickler spoke about. I took good care that my Commission got a copy of that *Hydro Ranger*. If you have complaints about not getting copies you need to jack up the Secretary.

The gas company is making an allowance of $20.00 for an electric range and they only give an allowance for wood or coal or gas ranges of $10.00. They double up on the allowance for electric ranges to give a little bit stiffer competition.

We feel that this effort is well worth while; that it pays us to get out and do everything we can to increase our load by the installation of electric ranges.

I don't know as I can report anything more but to say that we are actively trying to co-operate in the campaign.

* * * *

By V. A. McKillop, London Public Utilities Commission

I will give very briefly the results in London since April, 1935. In that period, a matter of about fifteen months, the Hydro Shop has sold 475 new ranges. Against these sales the trade-ins have run about 55 per cent. gas, 35 per cent. electric, and there have been about ten per cent. no trade-in at all.

During that same period the other dealers have disposed of approximately 117 ranges and against that 117 ranges our Commission has financed them to the extent of $14,000. We in London have endeavored also to induce people to use electricity for cooking by putting out trial ranges, either used ranges or the new Leader Range, selling at $59.50, and in that time we have put out 256 ranges on that plan. The consumer has the option, after six months, of either sending back the range, there is no obligation, or of buying that range or another range. It is merely put out there to show him what we can do with electricity for cooking, without any chance of losing his investment. Of those 256, there are still 98 on trial. Ninety-eight were also sold and of the 98 that were sold, 58 were new Leader Ranges and 40 were used.

The trial ranges which came back to us were sent back for various reasons. Some were as follows: The customers were moving out of town; the customer was moving to a home that did not have the necessary wiring. That reason is now done away with because we are now putting in free range wiring, on existing houses up to a maximum of $32.00 and in the case of new houses we allow only up to $15.00.

Other reasons are that the customer's credit was not approved, that the customer is out of work and obliged to go on relief, and that the customer for some unknown reason decides to use gas.

National Electrical Contractors Association

By Laurence W. Davis, General Manager

(Address to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Ottawa, July 3, 1936.)

THE electrical industry has made splendid progress in its engineering achievements. Such papers as we heard yesterday by Mr. A. M. Doyle and Mr. M. J. McHenry on the Economic Regulation of Distribution Circuits are outstanding examples of the high degree to which the engineers have raised the efficiency of production and distribution of electrical energy into the customers' meters. We heard discussed very dramatically and, I am sure, very convincingly, the importance of regulation of distribution so that customer good-will may be retained by maintaining a constant voltage into the meter. But I wonder how far we have fallen down as commercial engineers in the proper distribution beyond the customers' meters?

This morning the programme interested me very greatly. I think Mr. Adsett has produced a paper that is an equally outstanding contribution to our industry and the discussions that have followed have been splendid. In this problem of commercial distribution we are dealing with something that goes beyond inanimate elements which the engineer can handle and having found a method of balancing the load, can make those elements fixed. We are dealing with human elements and there is a problem which is never static. It is constantly in flux and there is need for some agency to be devised in our industry which will steady the economic channels of distribution before we can give utmost satisfaction to our industry, the public and the consumers.

This has been a matter of a great deal of study. There has been a recent development I want to very briefly tell you about and present as a thought for the adoption of the same principle throughout Canada.

Last December, the Executive Committee of the National Electrical Contractors Association, meeting in New York, extended through our President an invitation to the Presidents and the Boards of Governors of the other three national associations of the electrical industry in the United States to meet with us. Thirty-two men sat down to dinner at seven o'clock on an evening last December. We had in mind that perhaps by nine-thirty we would be through and we would dismiss them—but at midnight they were still sitting at the tables. Why? Because their imagination had been fired by the possibilities of the idea of setting up in the electrical industry of a promotion committee, with local industry co-ordinating committees in every trade center in the country, for co-ordinating the various existing agencies which today are going off in

their separate directions, and for co-ordinating the activities of all groups in our industry to do a more constructive selling job.

We have some very difficult problems to solve. In the matter of adequate wiring to provide for the needs of the public, our engineers, up to the customer's meter, have done a fine job, but do you realize all of the influences that are at work to prevent an equally good distribution job being done on the customer's side of the meter?

This is an industry problem. It is just as serious to your Hydro-Electric service when the customer who wants to use electrical services which are continually coming and made available for him, finds he has inadequate house wiring, inadequate service, too small sizes of copper, not enough outlets, as it would be for your engineers to fall down on their line distribution. You can't leave interior wiring to the haphazard, competitive conditions which may exist today and are responsible for them.

The programme is this: We are urging that in every province and every important trading center in each province there will be set up local industry co-ordinating committees or councils, having representative men selected by each group in the industry who will be charged with the responsibility of meeting at regular, frequent intervals to study the whole distribution problem, just as our engineers study the engineering problems. Representatives of the Hydro-Electric and of the power companies throughout the Dominion, representatives of the manufacturers, of wholesale distributors, the contractors, the electrical retailers and other merchandisers involved today in the distribution of electrical services.

Mr. Adsett's plan, just presented with his excellent recommendations—those in themselves are going to fail if we do not bring into step and have thoroughly in accord with the plan all the groups of the industry responsible for making this work.

I would like to leave with you this thought, if it be approved by your organization that initiative be taken to encourage this plan, that steps be taken for the setting up throughout your provinces of industry promotion committees, made up of representative men of each branch of our industry, charged with the responsibility of determining, each with their knowledge of the conditions of their branch of the industry, how we may co-ordinate the interests and activity of all groups in this constructive programme.

I thoroughly appreciate the expression that appeared in one of the papers read this morning, that the dealer and the contractor who are circumscribed by narrow local outlooks, may not at all times have co-operated in the past. There is another type of contractor, however, who is earnestly striving to serve the industry and the public efficiently.

To show you the sincerity of that type of contractor in this movement I have outlined, I would like to read a Pledge of Co-operation which they have given to the industry. They have made it an absolute requirement of membership in their national association and it has been adopted by both

Canadian and United States members, unanimously, as a basis for membership. Here it is:—

"As a qualification for membership in the National Electrical Contractors Association, we pledge active support and co-operation in the following ways for the betterment of the Electrical Industry and the public welfare:—

1. We adopt as the standard of our business as electrical contractors the following wiring policy established by the National Electrical Contractors Association:—

   The Association declares its policy to be the extension of electrical service to the greatest number of users, and to this end the Association believes that every effort should be made to reduce the cost of electrical installations through developments in wiring methods and installation practices consistent with the safety and convenience of the public which must be safeguarded at all times.

2. We will conduct our business along proper and ethical lines, keep an accurate record of all transactions and sell on a basis that will permit prompt payment of labor, materials and business expenses and meet our responsibilities to the customer and to the community.

3. We will at all times avoid the use of substandard materials, methods of workmanship, or any installation that falls short of adequate safety and service to the users of electrical energy according to legal requirements and duly approved standards.

4. We will actively promote to the best of our ability such standards as "Better Light—Better Sight", and all similar promotions designed by the electrical industry to render more adequate and satisfactory service to all users of electricity.

5. We will familiarize ourselves with the electric rates prevailing in our community in order to discuss intelligently with customers the cost of operating electrical appliances, motors, heating and cooking, as well as proper lighting.

6. We will actively promote the sale and use of current consuming devices, realizing that such promotion offers greater services to the customer, increased business opportunities for wiring, as well as in the sale of such appliances. If not stocking and selling such appliances, we will refer prospects for same to a regularly authorized and established dealer, preferably an active member of the Association.

7. We will not contribute anything, by word, action or otherwise, that will tend to destroy confidence in the electrical industry as a whole; nor will we permit unjustified attacks upon any branch of the electrical industry to go unchallenged without an honest effort to get at the source of complaint or criticism, and will endeavor, with the help of the Association, to adjust or remove

the cause and effect of same by proper methods of education or arbitration.

8. We subscribe to this pledge for the purpose of enhancing the usefulness of electricity to the public and for the rendering of more adequate and satisfactory service to all users of electricity.

9. It is understood and agreed that if we desire to withdraw from this Pledge of Co-operation, we may do so upon giving notice in writing of our intention to the National Electrical Contractors Association, whereupon our membership shall cease.

10. We agree that if any complaint of violation of this pledge shall be entered against us by a co-signer of the pledge, we will meet with the Executive Committee of the Association, or any representative of the Association appointed by the Executive Committee to investigate such complaint, and that if, after final review by the Executive Committee itself, such complaint is found to be true and inimical to the best interests of the public, the Association and the electrical industry, will forfeit our membership in the Association, and all benefits attached thereto, if required by the Executive Committee as provided for in the Constitution and By-Laws."

Gentlemen, there is the pledge of our group of the industry. I believe it represents a sincerity of purpose which justifies a response from all other groups of the industry. Therefore, I leave with you this invitation to your admirable association, to take an active part in the formation in both provincial and trade center groups, of local industry promotion committees, for the purpose of coordinating the four branches of the industry in doing the most constructive selling and market development job possible.

The Inactive Ledger

By I. N. Pritchard, Public Utilities Commission, Chatham

(Presented to Accounting and Office Administration Section, Association of Municipal Electrical Utilities at Ottawa, July 3, 1936.)

IMPROVEMENTS in our offices and office systems have been rapid during the past seven or eight years, and we can all compare the old set-ups with the present ones and enjoy some feeling of satisfaction from the comparison. It is incumbent upon us, however, to continue improving our records and also to keep abreast of changing conditions.

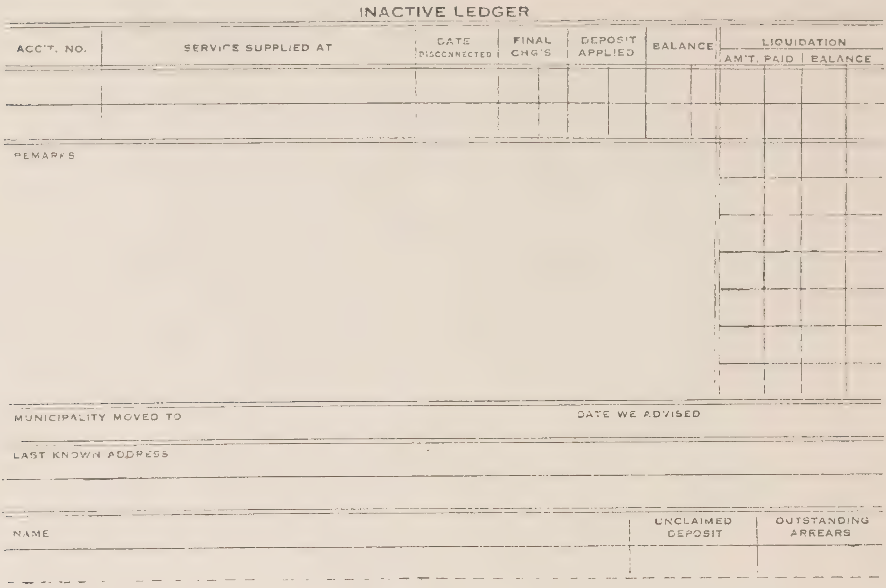
During the improvement period practically all Hydro Utilities have instituted Bad Debt Reserves and from time to time charges have been made against this reserve. The charges so made have been, for the most part, balances of accounts doubtful of collection, but certainly not in the true sense bad. The doubtful debts have been receiving considerable attention in a few municipalities during the past year and when properly recorded have proven to be assets rather than bad debts.

Doubtful debts include those left by consumers who have moved to another municipality or who have discontinued service for other reasons. When we have decided firmly in our minds the difference between a doubtful debt and a bad debt then we can pass along to the improvement which we have to suggest.

Instead of charging the doubtful debts to a reserve we charge them to a special Accounts Receivable account in the General Ledger and each individual account is recorded in what has been called the Inactive Ledger. The details of each account are recorded on a special card, a sample of which is attached to this sheet. The cards are arranged alphabetically and controlled. They should be balanced against the Accounts Receivable account in the General Ledger at regular balancing dates.

The card ledger is used in another capacity—the most important of all. The ledger is situated on the counter or other convenient location in order that the clerk who takes applications for service can refer immediately to the record and find if the prospective consumer's name is recorded in the Inactive Ledger. It has been found in practice more desirable to advise the applicants for service at the time of their visit or telephone call of any arrears previously contracted, rather than later to telephone or write them of the condition. This is a service that the consumer has a right to expect and also one of the services which an efficient staff should be glad to give.

At our last meeting in Toronto in January a municipal secretary advised that in 1935 over $600.00 was collected from the Inactive Ledger installation that would otherwise have been lost.



INACTIVE LEDGER

ACC'T. NO.	SERVICE SUPPLIED AT	DATE DISCONNECTED	FINAL CHG'S	DEPOSIT APPLIED	BALANCE	LIQUIDATION AM'T. PAID	LIQUIDATION BALANCE

REMARKS

MUNICIPALITY MOVED TO

DATE WE ADVISED

LAST KNOWN ADDRESS

NAME

UNCLAIMED DEPOSIT

OUTSTANDING ARREARS

Special card form for the Inactive Ledger.

Equipment

In some municipalities, where few inactive balances exist, it has been found extremely easy to list them instead of setting up a card ledger. In the municipalities where a number of such balances accrue from month to month, a card system is necessary in order to be able to locate quickly any card desired. In municipalities where a great number of balances become inactive, visible equipment is a necessity if service to the consumer and automatic balancing is desired. Many can visualize the advantages to be derived from visible equipment and signalled records. We believe that no matter what equipment is used the record will pay for itself in a very short time.

Installation

In order to include all inactive accounts in the new ledger the following records are necessary:—

- Doubtful accounts written off in previous years.
- Doubtful accounts from active ledgers.
- Inactive Consumers' Deposits.

The work involved in the installation of this record will be simple providing a good record has been kept of the accounts written off in previous years. In order to complete the work in the least possible time, all the cards should be made out before placing them in the visible equipment. If this is done the record will be alphabetical throughout. When part of the record is set up it is awkard to file the balance, as much switching of the cards is necessary to obtain a complete alphabetical record.

The journal entries will be made as follows:—

Inactive Accounts Receivable Dr.
To Bad Debts Reserve.

This entry will include all Doubtful Debts written off in previous years.

Inactive Accounts Receivable Dr.
To Active Consumers' Accounts Receivable.

Transferring all inactive balances from the active ledgers.

Consumers' Deposit Account Dr.
To Inactive Accounts Receivable.

Transferring all inactive deposits from the Consumers' Deposit Ledger.

When the installation is complete it will be found that few "Bad Debts" will be written off the active ledgers.

The reserve for bad debts should then be called "Reserve for Bad and Doubtful Debts" and the reserve will be gauged by the balance in the Inactive Accounts Receivable. This will facilitate the work of arriving at a figure each year to bring the reserve to an equitable amount.

Every application for service warrants the clerk looking for the name in the Inactive Ledger. It may be that an old balance or an old deposit, or part of an old deposit is awaiting the prospective consumer. When setting up this installation recently in one of our municipalities, a consumer was found in arrears at his present address who had previously left a balance of over $50.00 which had been written off against the reserve. The amount was billed and collected.

SUMMARY

This little reference to the use of an Inactive Ledger is made in the hope that the municipalities will profit by its use. We feel confident that the advantages accruing to the consumer and the utility, as well as the satisfaction obtained by the office staff, should warrant the immediate installation. There is no doubt that the cost of any necessary equipment and the work involved in setting up the record will be more than paid for in a very short time by the balances collected which previously were lost.

Shooting Trouble

THE difficulties sometimes experienced in locating trouble in a municipal electrical distribution system are aptly described in the following contribution by Dr. Julian S. Boyd, Chairman of The Public Utilities Commission of Simcoe, Ontario. Dr. Boyd, who is one of the most outstanding surgeons in Norfolk county, has taken a keen interest in Hydro in the Town of Simcoe for a number of years. This interest led to his election to the office of Commissioner on the Simcoe Public Utilities Commission, and although he continues to carry on professionally, yet he performs his duties on the Simcoe Commission in a most able manner. Being of a naturally enquiring mind, he follows the operations of the system closely and thereby keeps informed on all important details.

* * * *

A thick Manitoba maple. A grunt on the ground. Two men up the tree. A dead series line and a dead 2,300-volt feeder. Vagrant tickles from the leaves of the tree.

* * * *

A constant-current transformer disconnected from its feed. Two bayonet switches to be pulled. Two jolts. Some normal and typical remarks.

* * * *

A feeder smoking into a tree limb. A saw. A jolt when the limb separated. A flash when the limb goes across a dead series circuit and the system neutral. Some more normal remarks.

Patrols and more patrols. Deep and complicated discussions. Wish the rain would come and let the damn thing burn out. Let's patrol it again.

* * * *

Midnight. Factories closed down. Series circuit sparking to every leaf that touches it. Start cutting out loops. Limb of a handy tree makes a good indicator. Still sparks. Kill one 2,300-volt feeder. Sparks gone. Close breaker, more sparks. Half past one now. Remarks becoming more normal. Narrowed down to three business blocks, and a loop across the river. A pair of snatch-blocks to keep the line out of the water. A little spark up in the air out over the middle of the stream, and a few feet north of the bridge.

A bright piece of wire shining in the spot-lights as it comfortably rested across the series wire and a primary.

* * * *

Kids fishing for carp. A nice wire leader. A line flying through the air. A snarl and tangle. A jerk loose, leaving the leader. Now you've done it, run like hell!

* * * *

That is probably how it went, but it put most of Simcoe's radios out of business and puzzled the whole department for three days.

And we are still trying to decide whether the escape of the man who got the jolt from the saw and the limb is due to the fact that the devil looks after his own, or just plain cussedness.

Paint—A Partner in Better Seeing

By A. H. Kennedy, The Sherwin-Williams Company

NO one visiting the Chicago World's Fair could help but realize the close relationship of paint, daylight and electricity in the field of illumination. Night scenes reflected an awakening to lighting possibilities scarcely conceived a few years ago. Industry throughout the country is becoming more and more seeing-and-light conscious. Floods of non-glaring lights are being played over an ever-increasing number of complicated operations so men can work more comfortably, effectively, cheerfully and safely at their tasks. Industry is beginning to realize that humanitarian requirements are not so opposed to economic requirements as once believed. A tremendously important educational job of improving seeing conditions is being jointly done by our major power companies, the Lighting Research Laboratories of General Electric, the "Better Vision" and "Save the Surface" Institutes, the Sherwin-Williams Company, Weston Electrical Instrument Company, New Jersey Zinc Company and many other notable organizations.

Certainly the facts that about 40 per cent. of our workmen have defective vision and only about 15 per cent. have attempted to remedy their own condition should stimulate employers who are seeking maximum efficiency in their organizations to improve seeing conditions, especially since 85 per cent. of the impressions that govern actions are received through the eye. Furthermore, as tests have indicated that 25 per cent. of the human energy is consumed in seeing, provision of better seeing conditions has additional significance in plant management, because it reduces fatigue, which leads to sub-quality work, lowered morale and accidents. Tests have shown that better illumination increases speed of workmanship and precision in production, thereby offsetting the cost of additional light and paint applications. A more congenial factory spirit is also found where the workers' surroundings have been made bright and cheerful.

Deplorable Illumination

Visits by the author in numerous plants have revealed that there are countless small shops and a surprising number of large plants that are still laboring under inefficient and harmful light. Even in tool shops where micrometers and sixty-fourth-inch scales are used workmen are still straining under the intense and distinctly harmful light of tungsten lamps unshielded by shades or reflectors. Attempts to see the course of intricate tooling operations are being made in the face of glare, light spots and shadows. Printing-press operators, production and proof men are too often expected to perform accur-

ately with every conceivable light handicap.

Measurement of illumination, light spots and glare has been made easy and accurate by the foot-candle and sight meters. Insufficient light and an appalling lack of suitably dispersed light have been revealed by these means.

New possibilities and better applications of artificial light are being devised for use particularly where stainless steel, tin plate, polished aluminum and other reflective surfaces are involved. In many places direct lighting has necessarily been supplanted by semi-indirect or indirect lighting. With the latter, reflection from walls and ceilings must be relied upon for diffuse light. The specular and diffuse qualities of gloss, eggshell and flat finishes, and also the reflective values of certain colors have been studied by leading paint companies. The latter values, as determined by the Sherwin-Williams Company, are given in the accompanying table.

Where soot, fumes or other discoloring elements tend to reduce the reflective values of plain white paint, it is often desirable to use a good grade of "gloss-white", which does not so easily collect dirt and may be easily washed without injury to the finish. Where the light strikes the surface directly, however, a gloss finish may produce glare. In such instances "eggshell white", in which the gloss has been sufficiently reduced to prevent glare, is used to advantage. Good grades retain their whiteness and are sufficiently water resistant to avoid injury from washing.

Percentage of Light Reflected by Paints of Different Colors

White, new	82-89
White, old	75-85
Cream	62-80
Ivory	73-78
Green	48-75
Yellow	61-75
Buff	49-66
Blue	34-61
Pink	36-61
Gray	17-63
Tan, dark	30-65
Red, dark	13-30
Green, dark	11-25

For the inspection of stainless-steel sheets or other polished surfaces, specular reflection is desirable to detect flaws. This can be provided by lights of suitable power and size directly opposite the surfaces being inspected, and eye strain can be avoided by providing a high degree of visibility by properly painting the walls and ceilings.

In "Light Reflection Value of Color in Paint"* we are reminded that "black and gray have long been known to be conducive to melancholia and general depression in sensitive persons". Different colors produce different emotional reactions:—

Red has been found to induce temporary stimulation, followed by a nervous reaction, often accompanied by headache.

Blue induces calm contentment. Yet in one instance when the walls of an office where changed from a buff to blue, it was found the office had to be kept several degrees

*New Jersey Zinc Company, 1931.

warmer for the physical comfort of its occupants.

Green and yellow, in many persons, increase vitality and amiability. A very large manufacturer of food products whose workrooms are finished in white has found green to be an efficient "relaxing agent" in the rest rooms and company cafeteria.

Soft shades of green are particularly suitable for machines, due to their restful and harmonizing qualities. Other colors are often more desirable. Where heat is excessive, blue may add to the comfort of the worker. The color of the work done may also dictate a contrasting color for the machine, or, as in the food and drug industries, a white sanitary effect may be desired.

Saving the surface remains a major function of paint. But aiding the improvement of illumination and creating congenial atmosphere are other salient functions of paint. Electric light, daylight and paint combine to save eyes, reduce nerve strain and effect production economies that more than offset the cost of producing better working conditions.—*Electrical World*.

H.E.P.C. Window, St. Catharines.

Free Repair Plan in Smith's Falls

INAUGURATED on May 1st of this year, the Hydro-Electric free repair plan is meeting with popular favor and officials of the local Commission report a steadily increasing demand for the service. Household electrical appliances of every description have been repaired and placed in working order by Hydro workmen and at no extra cost whatever to the Commission a material increase in power consumption has been made.

The growing popularity of the free repair service is revealed in the fact that during May 32 calls were received and 31 articles were repaired while in July alone 134 calls were received and 117 articles repaired. During the three months' period since the service was inaugurated a total of 224 calls have been received and 207 articles have been repaired.

T. E. Foster, Hydro-Electric Commission chairman, points out that no charge whatever is made to consumers for the repair work, the owner of the appliance being charged only for parts used in repairing. The plan brings no extra cost to the Commission as all work is done by regular employees of the local Commission.

A considerable increase in domestic power consumption has also been noted during the three months' period and, while installation of new ranges and hot water heaters has, no doubt been responsible for much of this, the Commission feels that the repairing and placing in working order of many household appliances has also played a large part in increased power consumption. The figures for April show 1,800 horse power while the July figures show an increase to 1,943.7 horse power.

Hydro hot water heaters are also finding popular favor according to information as given the *Record-News* by Mr. Foster. One hundred and seventy-five heaters are now in operation and the Commission expects that more than 200 will be installed by the end of the year. Since January of this year no less than 42 hot water heaters have been installed and the revenue to the Commission from this branch alone is more than $3,000.

Local residents are urged to use the free service plan if they have electrical appliances not in working order. A telephone call to the Hydro-Electric office will bring full information and it is probable that these may be repaired at a very small cost.—*The Record-News.*

* * * *

The policy of giving free service to domestic electrical appliances as adopted in Smith's Falls has been advocated by the Hydro-Electric Power Commission of Ontario for a number of years. Similar plans have been put into operation by a number of other Hydro utilities and reports received from them show that the effort is proving itself worth while in each case, that the power used by the appliances that are returned to service more than pays for any expense to the utilities in making the repairs. It is hoped that more utilities will follow Smith's Falls' example.

Electric Supply of Fifty Years Ago

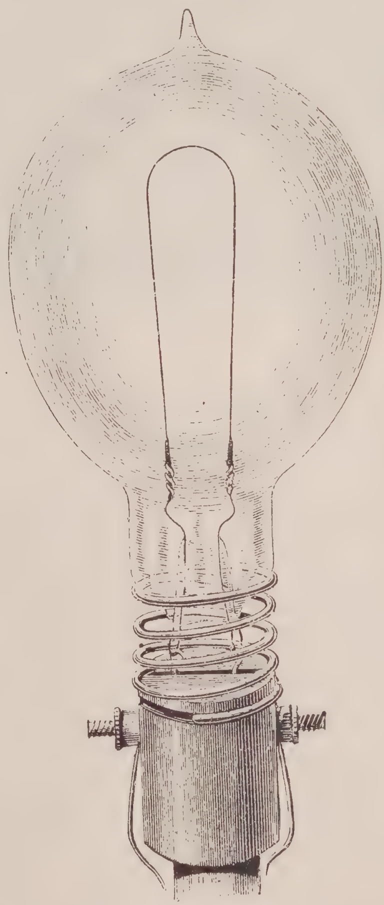
OLD books have a peculiar fascination for most of us, and occasionally a search in a second-hand bookstore yields something of an exceptional interest. Such a book which recently came to our attention is entitled "The Electric Light in Our Homes", by Robert Hammond, which was published in 1884, and was compiled from popular lectures delivered by Mr. Hammond in various parts of England. This gentleman, who evidently was a supplier of electric lighting plants, was an enthusiastic supporter of electricity in its early days, and was far-sighted enough to be able to foretell some events which have happened since his day.

It might be interesting to readers of *The Bulletin* to be furnished with an abstract of his book, which is a vigorous defense of the electric light against the attacks made upon it by the gas interests.

Mr. Hammond begins his lecture by describing the older forms of illuminants dwelling, particularly, on the inherent dangers of gas by reason of the consumption of oxygen and pollution of the atmosphere which may be charged against it. He then lays down the conditions required of a perfect light, which are as follows:

1. It should not rob the air of our rooms of oxygen.
2. Nor add noxious fumes to the air.
3. Nor be a source of danger in the house.
4. Nor be an unpleasant light.
5. Nor be difficult to control.
6. Nor be costly.

He dwells on each of these conditions separately and advances many interesting arguments to prove that the electric light satisfies all of them. He begins with a popular description of



Lamp and holder with spring and hooks.

Drawing-room lighted with electric wall fixtures, 1884.

the action of the electric current in producing light, particularly the filament.

In view of the recent controversies over the claims of Edison and other inventors to priority in the invention of the incandescent lamp, particular interest attaches to a table given in the book which contains the names of inventors who used carbon for filament as early as 1845, many years before Edison's work.

Mr. Hammond dwells at some length with the dangers from electric light dealing with dangers to life, dangers of fire and dangers to health. He disposes of the first by stating that if the voltages be kept to a reasonable value and the wires be covered by an insulating material, there is no chance of accidents occurring in connection with the electric light. As to the danger of fire, he provides for this by the insertion of what he calls "safety joints", which will "melt" when the current exceeds a safe value, and with this provision he asserts that all danger of fire is removed. Mr. Hammond's optimism may be excused on the ground that possibly the citizens in those days had not reached that stage of familiarity with electricity that breeds contempt and prompts the plugging of fuses, etc. His defense of electricity from the point of view of danger, however, is quite convinc-

Dining-room with pendent fixtures, 1884.

ing, particularly when he compares the danger of fire and accident with those inherent in the use of gas.

Mr. Hammond's treatment of condition four above is interesting and amusing. He compares the arc lamp with the incandescent lamp to the great advantage of the latter making a clever appeal to the fair sex as indicated from the following quotation:

"Two years ago the stewards of a fashionable ball in a garrison town thought they would provide a pleasing surprise in lighting the ball-room with the electric light. Now, unfortunately, the light chosen by them was the searching arc light, and I am sorry to say that, for some reason—up to the present time, of course, quite unknown to me, for one does not in any way pretend to understand the mysteries of ladies' toilets—two or three noble ladies preferred to sit in the shade during the whole of the evening, rather than dance in the full effulgence of the arc light. We may, however, be inclined to think that some question of color came into play—whether it was too much color or too little, the ladies present are at liberty to judge. I certainly determined from that hour never again to be a party to placing any lady in such a delicate position as that in which those unexpectedly found themselves that evening."

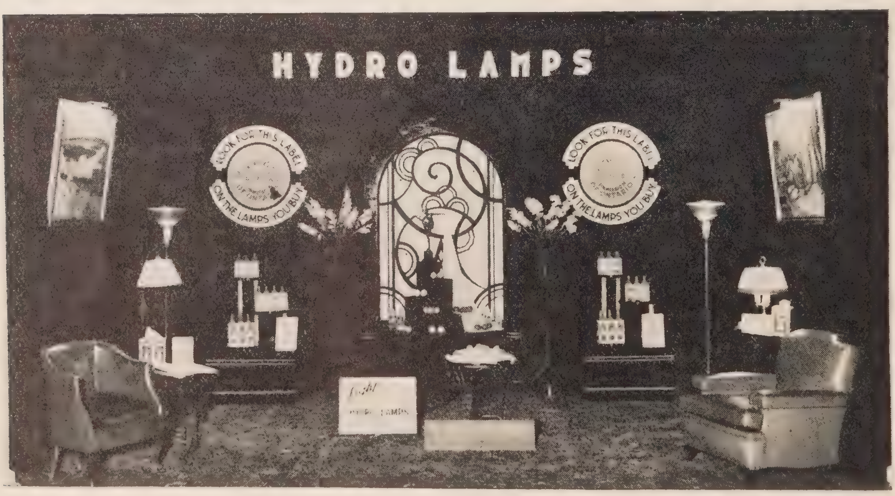
Considerable space is devoted to the fifth condition, that is, the control of

electricity, and illustrations are given of switches and lighting fixtures. Illustrations in Mr. Hammond's home indicate that he had made some progress in designing fixtures to distribute properly the light from bare lamps, and some of these fixtures would not appear to be out of place in present-day installations.

Mr. Hammond devotes the remainder of his lectures to the demonstrations of the thesis that electricity can be produced at a cost comparable with, and in many cases, lower than that of gas. He visualizes the great extension of central stations, he endeavors to show that many private installations can be made to produce electric light at a price equal to that charged at that time by the gas companies which was, roughly, 3s. 6d. per thousand feet. He describes the installation in his own house which consisted of a Ferranti dynamo driven by an Otto gas engine, which incidentally contained many ingenious "gadgets", one of which was a switch at his bedside to turn off the gas engine as he was about to retire. After presenting information on the cost of his plant, he arrives at the conclusion that he gains about thirty per cent. in actual production of light by passing gas through the gas engine to work the dynamo electric machine instead of burning gas direct.

He describes also methods of generating power by water and by steam engine and compares the cost.

It is curious that Mr. Hammond in spite of his evident farsightedness did not visualize the application of electricity to uses other than of lighting. The days of electric toasters, irons and washing machines were then undreamed of.



Comets

AT the present time a new comet is rushing across the sky from north to south. Whence did it come,—and why? Whither is it going,—and how soon will it return? These questions are asked, and many others regarding its composition, its effect upon the weather and the predictions it has brought as to individual and national affairs.

This comet, rated the brightest since Halley's, in 1910, was discovered on the evening of May 14th last by Leslie C. Peltier, a young amateur astronomer in Ohio, whose diligence in searching the skies had already been rewarded by the discovery of four other new comets. It is very remarkable, however, that a comet should have been allowed to come so near to the solar system as this one had done without being caught in the telescopes of the large observatories.

After a comet is discovered, it is carefully observed until sufficient information has been obtained for the calculation of its orbit and conclusions reached as to its general behavior. The news then is given to the public if it appears that the comet will be of interest to them.

Peltier's comet was in the Milky Way when announced in the press and was practically indiscernable with the unaided eye: the public were intensely interested but only a very few could find it. Those who did locate it, found it an exceedingly beautiful object in a telescope or field glass, Fig. 1.

Comets mostly are self-luminous gaseous bodies which travel around the sun under the same laws as the nine planets. The orbits of some of them, however, are very long ellipses so that these comets go to far distant parts of the Universe and return only after long intervals of time; these are known as periodic comets and are considered part of our solar system. The orbits of other comets are of such shapes,—parabolic or hyperbolic, Fig. 2,—that they never return; they come from the distant unknown, are seen here for a short time and then depart into the unknown again,—very typical of life.

A comet, as seen from the earth, usually has three parts,—the nucleus, the coma and the tail.

(a) The nucleus is the most dense and brightest part,—the centre, or core of the head.

(b) The coma is that indefinite hazy part surrounding the nucleus and appearing rather nebulous. (The word, "coma", means hair.)
The nucleus and coma together form the head.

(c) The tail is the visible extension of the coma in streamers away from the head.

Comets do not have tails until they approach the sun. The tail is formed due to the pressure of sunlight against the rarefied gas particles of the coma, the repulsion being greater than the gravitational attraction of the sun for material of such very low density. A comet's tail, therefore, is directed away from the sun,—not following

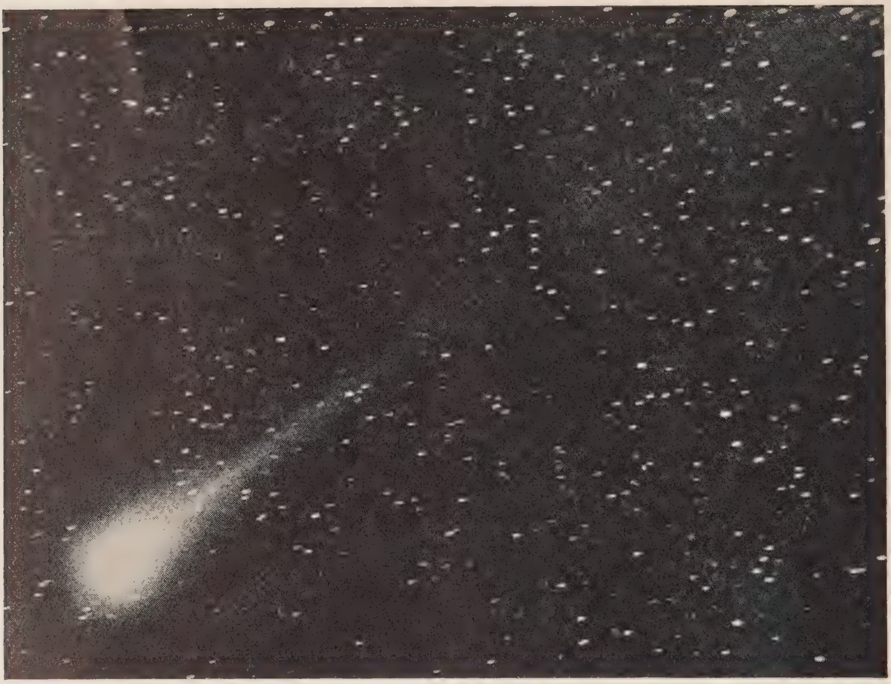


Fig. 1—Peltier's Comet, July-August, 1936.
A very rapidly moving comet,—travelling from left to right.—
Yerkes Observatory.

the head as a string would follow a stone to which it is tied,—and after the comet has passed the sun the tail precedes the head,—a rather difficult thought to comprehend.

With some comets, jets are observed starting from the head. Fig. 3. Encke's comet, Fig. 4, which returns every 3.3 years, has not a tail.

There is a very wide difference in the brightness of comets, greater than with any other heavenly bodies. Some are so faint that they can barely be seen in very large telescopes whereas others are sufficiently brilliant to outshine the moon. In 1882 there was a comet so bright that it could be seen even while the sun was shining by merely shading the eye with the hand. There was another bright daylight comet in 1910.

It may be that some comets have solid particles in their nuclei. If so, these must be few and very small as no trace of such material can be seen when a comet's head passes directly between the earth and sun. Furthermore, solid material would reflect sunlight and the comet's head consequently would grow brighter as it approached the sun. While there is an observed increase in brightness in the nuclei of some comets, the change, however, is not nearly as much as should be found with solid particles moving in the same orbit. The coma

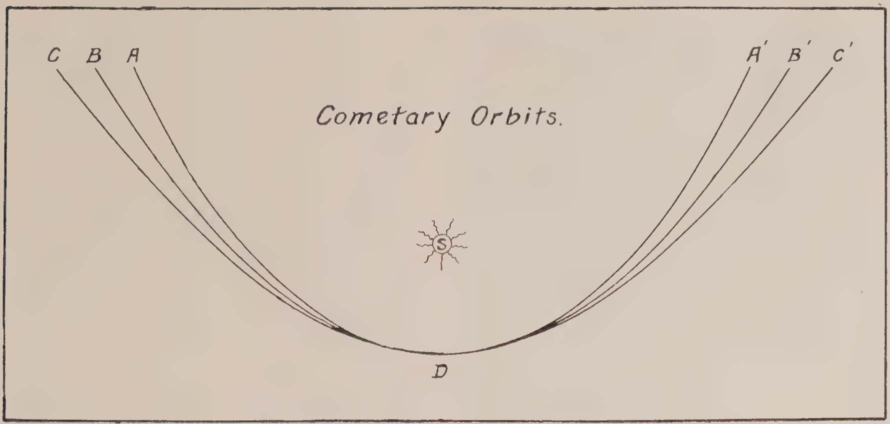


Fig. 2—Cometary Orbits—
AA'—An elliptical orbit,—comet will be periodic.
BB'—The parabolic orbit,—comet will not return.
CC'—An hyperbolic orbit,—comet will not return.
The more nearly an elliptical orbit approaches the parabolic curve, the longer will be the period of the comet.
D—Perihelion position,—where the comet is nearest to the sun.

and tail can be composed only of rarefied gases.

Some comets have been "captured" by Jupiter or Saturn. This does not mean that they have been held by the planets to revolve around them in the manner of satellites but rather that the comets have been drawn from

Fig. 3—Morehouse Comet, 1908,—showing jets from the head.—Yerkes Observatory.

Fig. 4—Encke's Comet, 1914,—a periodic comet returning every 3.3 years: it does not have a tail. The long star trails show that the comet travelled a considerable distance while this photograph was being taken.—Yerkes Observatory.

Fig. 5—Brooks' Comet, 1911,—a periodic comet with a long streaming tail.—Yerkes Observatory.

their orbits, one way or the other, by the attraction of the planets, and their periods, in consequence, have been shortened or lengthened. As an example,—Brooks' comet, Fig. 5, had a period of 29.2 years but on July 20th, 1886, it approached very close to Jupiter and by this encounter its period was shortened to 7.1 years.

When a comet leaves the solar system, it may be captured by some dark body near its course. If attracted by a star or distant sun, the gaseous material may all be repelled before the nucleus reaches the centre of attraction and then all that would arrive would be a few solid particles,—if such actually be in the comet's composition.

Comets are usually named after the observers who first discovered them, e.g., Morehouse, Brooks, Peltier, etc. In some cases the names of two observers, the discoverers of the comet on its successive visits, are linked, as with the Pons-Brooks comet found by Pons in 1812, and by Brooks on its return in 1883.

Halley's comet, which probably is the most famous of all comets, has been named after the man who first computed its orbit and predicted its periodic return. Records of the regular appearances of a very bright comet, in corresponding position in the sky, date back to the year 87 B.C. Edmund Halley observed it in 1682 and found its orbit nearly identical with comets which had appeared in 1531 and 1607, recorded respectively by Apian and Kepler. He studied records back as far as the year 1066 and noticed variations in the interval but attributed these to attraction by Jupiter and Saturn. Halley was convinced that this was one and the same comet which had been appearing regularly over the many centuries, the average interval being 77 years. He therefore predicted that this comet would return early in 1759.

When that year arrived, the comet appeared as prophesied. Before the time that it was next due, in 1835, mathematicians had calculated the month and day on which it would pass the sun, at "perihelion", or minimum distance, and were just two days in error in their estimates. This is the first periodic comet whose return has been predicted.

On its latest return, April, 1910, it was first photographed when 310 mil-

lion miles distant from the sun, about nine months before it was interesting observers on the earth. It was followed, by photographs, for about fourteen months after it passed the sun, until at a distance of 520 million miles away. On this occasion, the head crossed directly between the earth and sun.

This comet was a very spectacular object having a brilliant head, the nucleus of which shines partly by reflected sunlight, and an exceptionally long tail. It was first observed in the morning sky but, after passing the sun, was again seen in the evening. The head and tail were found to contain both cyanogen and carbon monoxide, two deadly gases, so asphyxiation of the entire world population was prophesied by some. The date on which the earth was to pass through the tail, May 21st, was anticipated with great fear,—but nothing happened. This comet will come back again about A.D. 1986.

Comets should not be confused with meteors or fireballs,—"shooting" or "falling stars",—which are our near neighbors performing in our upper atmosphere whereas the comets are millions of miles distant. Comets, too, should not be interpreted as bringing any predictions, except perhaps as to their periodic return. They are merely heavenly bodies travelling in their orbits around the sun in an enormous and practically perfect vacuum, according to the same law of gravitation which keeps the planets in their places. Probably the strangest feature in comets is that by their streaming tails they demonstrate, as we do not see so clearly elsewhere, the remarkable effect of the repellent force of light.—*F.K.D.*

Fig. 6—Halley's Comet, 1910,—probably the most famous of all comets, named after the man who first computed its orbit and predicted its periodic return,—at intervals averaging 77 years.

Association of Municipal Electrical Utilities

Report of Committee on Overhead Crossings

YOUR Committee, consisting of Messrs. Schwenger, Bradt, and McKillop met with Mr. A. E. Davison of the H.E.P.C., for the purpose of reviewing the draft specifications submitted under the direction of the Canadian Engineering Standards Association, draft of February 1st, 1936, covering "construction of overhead, underbridge and underground crossings, involving railways, supply lines and/or communication lines."

After careful consideration of this specification, the following resolution was passed:—

We are opposed to the adoption of the proposed specifications because:—

1. The occasion for abandonment of existing rules, originally issued under General Order No. 231 of the Board of Railway Commissioners for Canada, and revised from time to time, is not made clear.

2. Proposed rules and specifications are quite too difficult to interpret and are overdone to the point of confusing a user with a multitude of details sometimes conflicting.

3. Greater strengths are required than are now found to be necessary for safety over a long period.

4. Rules of this type should be so simplified and so easily understood and interpreted that field inspectors can satisfy themselves that crossings are up to standard.

5. It should not include telephone crossings.

6. It contains too much detail which is not fundamental to economic and safe construction.

7. The large number of appendices should not be a part of the specifications.

8. It will increase the cost of crossings unnecessarily.

9. It is, according to our reading, retroactive, although it has been said that retroactive features are not intended.

10. Results to be obtained should be specified rather than methods. And since the proposed regulations regarding electric wires along and across railways, as prepared by a committee of operating engineers, dated September, 1935, is more suitable for these purposes, your Committee recommends that this Association approve in principle this draft, subject to minor additions and alterations, including the following:—

1. A general statement that all details not specifically stated shall be satisfactory to Board Engineers.
2. Minimum horizontal separation at supports such as Table VI, N.E S.C.
3. Minimum clearances in any direction from line conductors to supports and to vertical or lateral conductors span or guy wires attached to same support, such as Table IX,

N.E.S.C. We intend that vertical clearances need not be as great at a structure where wires are fixed as they should be where movements of each of the wires are involved as in the middle of a span.

4. Vertical separation of cross arms, carrying conductors, such as Table XI, N.E.S.C.
5. Vertical construction—0-750 volts across minor tracks be allowed on racks at 25-ft. level.
6. Clarify loading districts, also the intent of ice and wind loadings.

André Marie Ampère

ONE hundred years ago, on June 10th, 1836, André Marie Ampère, mathematician and physicist died at Marseilles, France.

Ampère was born at Polemieux near Lyons on January 22, 1775. When Lyons was taken by the army of Convention in 1793, his father, who was a strong loyalist and holding the office of *juge de paix,* was thrown into prison along with many of the sympathizers and soon after became a victim of the guillotine. This event produced a profound impression on the mind of André Marie, then a student, and for more than a year he remained in a state of melancholy from which he sought to find relief by redoubling his studies.

From about 1796 he gave private lessons at Lyons in mathematics, chemistry and languages and in 1801 became professor of physics and chemistry in the central school of the department of Ain at Bourg, leaving his ailing wife and infant son at Lyons. His wife died in 1804 and he never recovered from the blow. Later he became professor of mathematics at Lyons and in 1809, professor of mathematics at the Ecole Polytechnique in Paris. Here he distinguished himself as a very able teacher. He began his career as author in 1802 by writing an essay on the mathematical theory of chances, *Sur la théorie mathematique du jeu.* In 1814, Ampère was elected Member of the Academy of Sciences and in 1824 appointed professor of experimental physics in the College de France.

Science is largely indebted to Ampère, especially for his electrodynamic theory and his original views of the identity of electricity and magnetism as given in his *Recueil d'observations électro-dynamiques* and his *Théorie des phénomènes électrodynamiques.* He was the inventor of the astatic needle which made possible the modern static galvanometer. He was the first to show that two parallel conductors, carrying currents travelling in the same direction, attract each other, while if travelling in opposite directions they are repelled. He also formulated the theory that there were currents of electricity circulating in the earth in the direction of its diurnal revolution which attracted the magnetic needle. The whole field thus opened up he explored with characteristic industry and care, and developed a mathematical theory which not only explained the electro-magnetic phenomena already observed but also predicted many new ones.

Ampère's name is perpetuated in that of the electrical unit of current.

From the Sublime to the Ridiculous

By Mabel Wray

IT is always possible to regard past and gone happenings with a reasonably favourable eye but at the time of their occurrence what a different viewpoint we all have.

A few weeks ago I was called away into the country at a minute's notice, to nurse a sick relative, and I quickly realized how fortunate I am in having plenty of appliances to help me in my work, and how unfortunate I was during my temporary sojourn in the country.

I arrived late at night and the first snag was that of hot water, both for drinking and for washing. The kitchen of the house is fitted with an old-fashioned kitchener, very bright and shining and covered with ornamental knobs, with most of which I made violent and intimate contact with my knuckles the following morning during cleaning operations.

Filling the kettle and putting it on the fire was my first job—I badly needed a cup of tea in spite of the lateness of the hour and the kettle was eleven minutes before it boiled, notwithstanding a huge fire of Derby Brights.

However, arising next morning quite early, I tackled the first job in such a house, i.e., the fire, and what a job! Never have I found such a mass of dust and dirt. The firebars were fixed and all the ashes had to be raked out, not only from under and over the grate proper, but from all sorts of weird passages under and around the side-oven and the side-boiler. Boiler is not a good word really, as the water in it never boils; it may simmer occasionally, but no more than that. I managed to get it clear at last. I was, by that time, frozen to the marrow, and lit the fire and waited until it had burned through before putting the kettle on. I missed my early morning cup of tea, which my husband gets for me every morning at home, taking only a few minutes over the job; if it took very long I am afraid I should have to do without it, but I find that electrical appliances make good husbands.

The first day was Sunday, there was an invalid to be attended to and dinner to cook. I have cooked a dinner in a side-oven, many years ago, but I seem to have lost the knack; at any rate, I eventually produced a respectable meal, but was so overcome by my efforts, my face was the colour of a pickled cabbage, that I could not swallow a mouthful. I had cooked myself as well as the dinner. Then came the business of washing up. No hot water in the scullery; it had to be drawn from the side-boiler, augmented by water from a large iron kettle put on the fire after the pot and steamer had been removed when dishing-up the vegetables.

Didn't I wish for hot water over the scullery sink, but my house was miles

away and I had to put up with archaic methods. One good thing the prolonged washing-up did for me, was that it eradicated, in parts, the marks left on my hands by my struggles with the coal-fired and black-leaded kitchener.

Washing up done, the side-boiler was empty, the fire was low, so I put a couple of buckets of water into the boiler, some of it went over the fire and the grate, as the hole in the top of the boiler was ridiculously small, and I carted coals into the house from an outhouse conveniently situated at the bottom of the garden, at that time very wet.

The invalid had a coal fire in her bedroom; coals to be carried upstairs made things much more pleasant as the energy required kept me warm. Sunday over, with its prolonged waits for water to heat, I went to bed praying for the arrival of electricity at the house where I laboured.

My sister had been ailing for some little time, and there was rather a large pile of washing awaiting attention. Laundries are anathema in our family, so on the Monday morning I got down to it. The method employed is common to thousands of country homes, and husbands should be made to spend at least one wash-day at home and to do the washing. They would soon appreciate what their wives have to put up with.

The washhouse is not attached to house proper, but is an outbuilding, containing a copper, brickset, served by a short chimney, which usually gives plenty of back-draught. I filled the copper as soon as I got up, carrying out buckets of water to do so, lit the copper fire, which promptly went out, owing to the flues being damp and cold due to disuse, eventually got the fire going, went in the house and made the fire in the kitchener and prepared breakfast, not an easy job. It was two hours before the water in the copper was hot enough to use, but after using a dolly tub and "peggies", an old fashioned wash tub and an antique wringer, I finished my wash just before 4 p.m. It was pouring with rain all the time, water had to be carted from the house at frequent intervals, and altogether it was a wash day to be remembered. I shall never forget it, especially as all the clothes had to be dried in the house, and meals prepared throughout the day under inefficient conditions.

Ironing was a dreadful job as I reverted, of necessity, to the heavy flat irons, heated on the kitchener fire, using plenty of bath-brick powder to ensure absolute cleanliness. I was hours and hours ironing, the irons seemed to get cold so quickly, and there is no doubt that I appreciated my electric iron at home, safe and clean, very much.

This is rather a doleful story; fortunately for me, it lasted only two weeks, and never was I so relieved to be home again, with my electrical gadgets. I found a huge pile of washing awaiting me, three weeks in all, as my wash-day was due when I was called away. The first Monday at home I spent with my electric washer and iron, and I had finished the lot before 3 p.m., washed, dried and ironed. What a difference, coupled to the fact that I didn't start until late in the morning. I had plenty of hot water,

breakfast was a simple matter, there was no kitchener to clean and fires to light, and I am sure that if those women who have to work as I did during that terrible fortnight, could see me do more *useful* work in much less time, and with about a twentieth of the labour, they would not be satisfied until they had followed my example. I find electricity clean, quick, labour saving, and *cheap*, and I recommend those ladies who have not yet tried it to do so at once.—*Rural Electrification and Electro-farming.*

Employee Representation Plan

Unit No. 1, District 2

Accordingly Invites You to Attend Their

First Annual Banquet

To be held in the

Oak Room, Union Station, Toronto

at 7 p.m. on Wednesday, October 21, 1936

From the speakers of the evening you will learn the value of the Plan and the different features it embodies for the welfare of Employees.

A. J. MOIR
Chairman of Banquet Committee
Strachan Avenue Substation
Toronto

THE BULLETIN

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Hydro Exhibit Canadian National Exhibition

ONE of the principal attractions in the Electrical Building at the Canadian National Exhibition this year was the Hydro-Electric Power Commission Exhibit.

Located in the very centre of the building it formed an imposing display, around which the exhibits of various branches of the electrical industry seemed to rotate.

The exhibit consisted, as can be

Modern kitchen displays.

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Vol. XXIII **No. 9**

SEPTEMBER, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

seen by the illustrations, of a main central motif, a memorial to Sir Adam Beck, and on one side of this motif was a "Better Light Better Sight" demonstration booth, while on the other there were shown two model kitchen set-ups, one of a De Luxe type kitchen, and the other a more moderate one.

The whole floor was painted in modernistic fashion in bright and vivid colors, and on either side forward of the main display, were two pedestals on which were placed household and

Rear view of complete exhibit.

Front view of complete exhibit.

Modern home lighting display.

farm appliances. These pedestals were surmounted by a housing which contained an automatic projecting machine, by means of which photographs, showing the use of Hydro for the farm, the home, industry and lighting purposes, as well as a complete showing of pictures of Hydro plants, were automatically projected on the screen,

The back of the main display consisted of a farm equipment booth, on either side of which the series of show windows displayed various electric appliances and lamps.

The whole display attracted considerable attention and much interest was shown in the modern kitchen and lighting demonstrations.

Big Chute development, Severn River.

Electrical Cooking School at the Canadian National Exhibition

ONE of the principal features of the Canadian National Exhibition this year was an all electrical cooking school sponsored by the manufacturers of ranges and refrigerators, as well as the Toronto Hydro-Electric System, the Hydro-Electric Power Commission and the Canada Starch Company.

This cooking school was held in the Auditorium in the Electrical Building.

The school was very ably conducted by Mrs. H. M. Aitken, dietetic expert of the Canada Starch Company, and those who attended were taken on a world cruise. The stage setting resembled an ocean liner, and each afternoon and evening the liner docked at a different foreign port, the menu for each session being adapted to the port of call.

The electric ranges and refrigerators of each manufacturer were used in preparing the meals for each menu and the manufacturers contributed generously to the success of the school by advertising and the distribution of door prizes.

The total attendance at this demonstration during the course of the exhibition was over 40,000, which shows conclusively the effect of the enthusi-

Exhibition Cooking School—daily crowds.

Cooking School scene showing ship's galley.

astic co-operation of the sponsors.

Last year a similar demonstration under the same director, but without the sponsorship of the electrical industry, resulted in attendance of about 19,000 people.

It is hoped that next year still better results will be obtained.

Domestic and Commercial Revenue and Consumption Again Show Decided Increase

By P. T. Seibert, Sales Department, H.E.P.C. of Ont.

THE revenue and consumption of the domestic and commercial consumers served by Hydro Municipalities in the Province of Ontario have always shown a yearly increase except for the year 1933 when the decrease was very small. The 1934 and 1935 increases were above the average.

From year to year figures have been submitted to show what has been taking place in the domestic and commercial fields. Tables and graphs have been presented to show the growth in revenue and consumption. These figures and graphs have been brought up to date and are presented herewith.

Table No. 1 gives data for domestic consumers in cities of over 10,000 population, showing the annual revenue, kilowatt-hours consumed, number of consumers, the average cost per kilowatt-hour, the average monthly bill and the average monthly consumption. A study of this table will show that, as stated above, there has been a steady increase in the revenue and consumption up to the end of 1932.

TABLE NO. I
Data for Cities over 10,000 Population
DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	12	$ 614,925.00	12,646,400	55,597	4.86c	$1.06	21.8
1917	19	1,063,264.00	36,693,100	107,248	2.89	.88	30.5
1920	21	1,926,924.00	84,328,000	154,186	2.29	1.11	48.4
1923	21	3,772,416.00	206,266,200	223,028	1.83	1.53	83.5
1926	21	5,374,069.00	324,290,285	255,109	1.66	1.80	108.0
1929	26	7,530,748.75	497,102,897	309,645	1.51	2.08	137.2
1932	26	8,491,082.70	593,618,860	323,844	1.43	2.18	152.8
1933	26	8,495,321.93	595,211,863	330,597	1.43	2.14	150.0
1934	26	8,847,953.71	640,691,529	331,120	1.38	2.23	161.2
1935	26	9,096,420.26	664,178,767	335,467	1.37	2.26	165.0

TABLE NO. II
Data for Towns over 2,000 Population
DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	19	$ 90,330.00	1,414,500	7,410	6.38c	$1.11	17.4
1917	27	180,075.00	3,824,600	15,731	4.71	1.01	21.4
1920	36	353,915.00	10,053,100	24,041	3.50	1.26	36.0
1923	43	651,499.00	25,411,300	34,135	2.56	1.57	60.1
1926	48	1,037,016.00	50,487,035	47,873	2.05	1.84	89.6
1929	54	1,474,547.24	68,283,456	57,699	2.16	2.11	97.8
1932	59	1,595,906.55	81,054,613	62,843	1.97	2.11	107.5
1933	60	1,584,772.57	82,321,996	63,910	1.92	2.07	107.3
1934	60	1,624,571.42	86,037,603	64,921	1.89	2.09	110.4
1935	61	1,653,183.06	88,554,262	66,495	1.87	2.07	111.0

TABLE NO. III
Data for Villages under 2,000 Population
DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	18	$ 24,913.00	291,000	1,859	8.55c	$1.10	13.1
1917	77	97,516.00	1,412,500	8,334	6.90	.96	14.0
1920	109	233,819.00	3,829,900	15,665	6.00	1.29	21.2
1923	142	531,505.00	11,249,100	29,689	4.72	1.59	33.7
1926	174	942,309.00	29,945,632	46,900	3.15	1.71	54.4
1929	193	1,251,564.03	46,755,369	57,075	2.68	1.80	67.2
1932	213	1,589,233.10	66,226,945	65,928	2.40	2.01	83.7
1933	214	1,559,083.62	64,651,543	66,371	2.41	1.96	81.2
1934	214	1,605,544.56	70,803,577	67,872	2.27	1.97	86.9
1935	215	1,643,932.71	74,239,844	69,303	2.21	1.98	89.3

TABLE NO. IV
All Municipalities Totalled
DOMESTIC SERVICE

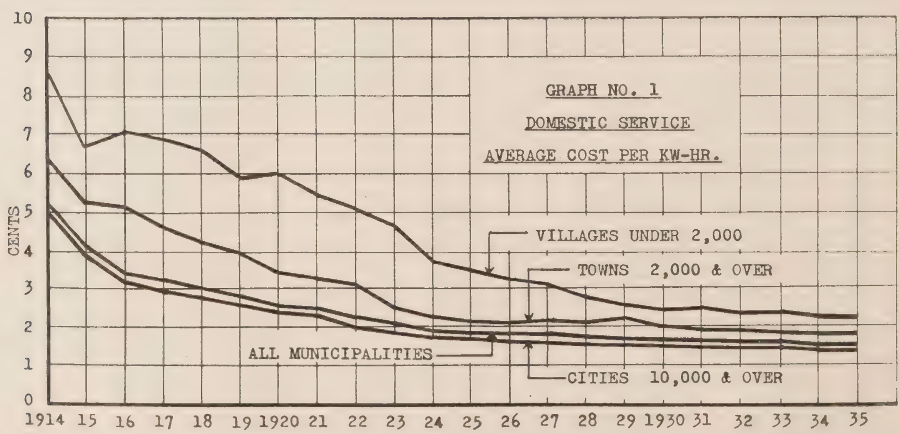
Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	49	$ 730,168.00	14,359,100	64,866	5.08c	$1.06	21.0
1917	123	1,340,855.00	41,930,200	131,313	3.20	.91	28.6
1920	166	2,514,658.00	98,211,000	193,892	2.56	1.15	44.6
1923	206	4,955,420.00	242,926,600	286,852	2.04	1.54	75.7
1926	243	7,353,394.00	404,722,959	349,882	1.81	1.79	98.4
1929	273	10,256,860.02	612,141,722	424,419	1.67	2.05	122.5
1932	298	11,676,222.35	740,900,418	452,615	1.57	2.15	136.4
1933	300	11,639,178.12	742,195,402	460,878	1.57	2.10	134.2
1934	300	12,078,069.69	797,532,709	463,913	1.51	2.17	143.3
1935	302	12,393,536.03	826,972,873	471,265	1.50	2.19	146.2

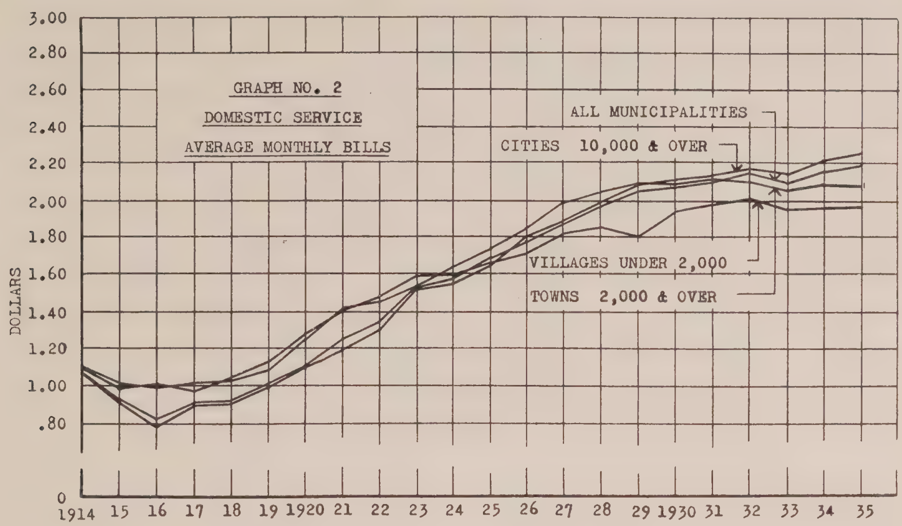
In 1933 there was a slight reduction in the average monthly bill and the average monthly consumption. The 1934 and 1935 increases in revenue and consumption were above normal.

Table No. 2 gives data for domestic consumers in towns over 2,000 population and in this table it will be seen that both the revenue and consumption have increased during the year 1934 and 1935. The averages shown are very encouraging.

Table No. 3 gives data for domestic consumers in villages under 2,000 population. The merchandising activities in these centres is negligible and the lack of employment has perhaps induced the residents in smaller places to economize more than is necessary in larger places. The increases in 1934 and 1935 have more than made up for the decline of 1933.

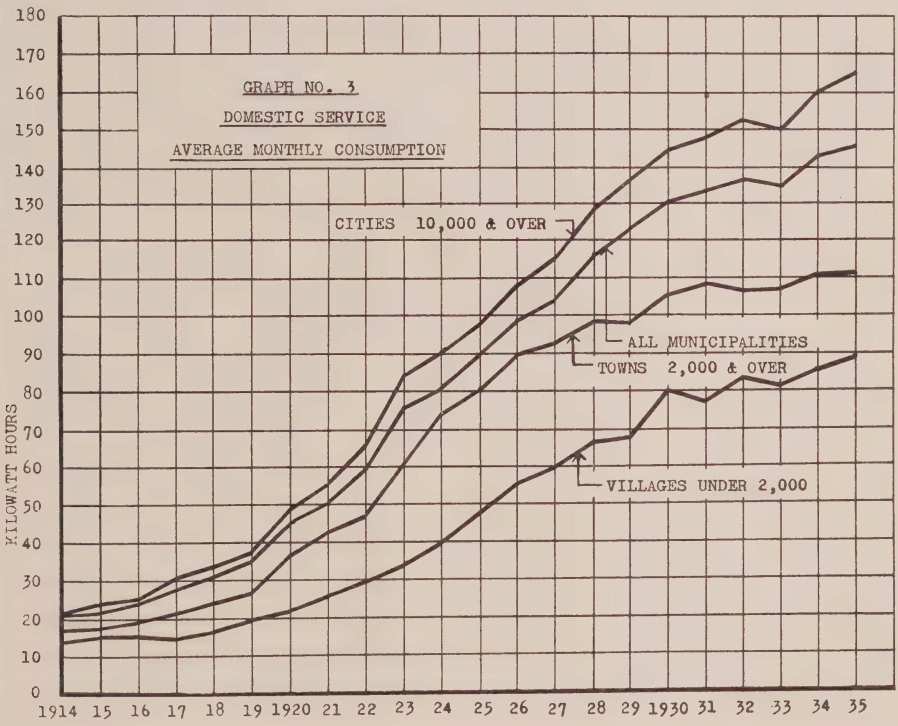
Table No. 4 gives data for domestic consumers in all municipalities served by the Hydro-Electric Power Commission of Ontario. The 1934 and 1935 figures compared with those of previous years show the encouraging re-





sults of the Commission's merchandising activities.

It might be interesting to note here that one reason for the fact that domestic consumption has increased is the introduction of the Hydro Flat Rate Water Heater Campaign, the effects of which are now being felt.



One of the outstanding conclusions to be drawn from the figures presented in these tables is the fact that while power loads the world over have declined since 1930 the use of electricity by domestic consumers has not only shown no decline but has grown steadily, and it seems as though a development of load among domestic consumers is exceedingly desirable if stability is to be maintained.

That there is a vast field awaiting cultivation among domestic users is revealed by the fact that the average monthly consumption among domestic users in Ontario is but 146.2 kilowatt-hours, or 1,754 kilowatt-hours per annum, compared with a possible consumption of nearly 8,000 kilowatt-hours per annum for an average home. The field is apparently only 21.9 per cent. developed.

To further illustrate the effect of time on Hydro development, a few charts are presented which are self-explanatory.

Graph No. 1 shows the average cost per kilowatt-hour for each of the four groups which go to make up tables 1 to 4.

Graph No. 2 shows the gradual growth in the average monthly bills among domestic consumers for the same groups.

Graph No. 3 shows the average monthly consumption per domestic consumer similarly classified.

It is to be expected with a marked decline in the use of power for lighting purposes in industrial plants for office lighting and other purposes there would be a considerable decrease in the use of electricity by commercial users. As an actual fact, the consumption and revenue produced by commercial consumers in Ontario have suffered very little.

Table No. 5 gives data for commercial consumers for cities of over 10,000 population and under the same headings as the tables for domestic users. In this table it will be seen that up to 1931 the revenue and consumption increased steadily. The years 1932 and 1933 show a slight decrease, but 1934 was almost equal to

TABLE NO. V

Data for Cities over 10,000 Population

COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	12	$ 536,350.00	14,048,500	12,439	3.80c	$3.94	103.7
1917	19	642,989.00	27,479,800	19,573	2.34	2.96	126.6
1920	21	1,103,599.00	50,358,000	25,505	2.19	3.77	172.0
1923	21	2,043,197.00	91,146,500	32,016	2.25	5.56	246.9
1926	21	3,393,186.00	147,581,714	40,675	2.30	7.08	308.0
1929	26	4,772,209.30	230,263,364	48,713	2.07	8.49	401.5
1932	26	5,088,113.49	254,512,316	51,753	2.00	8.19	409.8
1933	26	4,910,798.54	242,854,622	51,769	2.02	7.90	390.9
1934	26	5,078,662.53	256,071,970	51,118	1.98	8.28	417.5
1935	26	5,286,039.72	273,302,264	50,835	1.93	8.66	448.0

TABLE NO. VI
Data for Towns over 2,000 Population
COMMERCIAL SERVICE

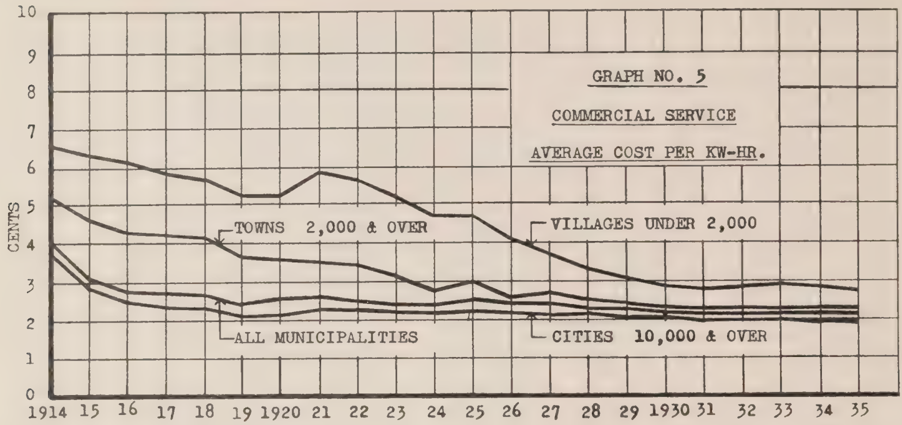
Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	17	$ 71,457.00	1,362,000	2,393	5.25c	$2.61	49.8
1917	27	134,730.00	3,100,600	4,107	4.35	2.76	63.5
1920	36	221,867.00	6,179,400	5,736	3.59	3.30	91.8
1923	43	315,530.00	9,598,000	7,086	3.29	3.76	114.3
1926	48	430,467.00	15,709,616	8,310	2.74	4.31	160.0
1929	54	632,010.30	26,240,436	10,214	2.41	5.13	213.1
1932	59	723,774.94	31,786,728	11,359	2.28	5.31	233.2
1933	60	663,596.72	29,864,388	10,966	2.22	5.04	226.9
1934	60	684,126.46	30,149,378	11,142	2.27	5.12	225.5
1935	61	717,248.27	32,555,348	11,310	2.2	5.28	239.9

TABLE NO. VII
Data for Villages under 2,000 Population
COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	14	$ 16,974.00	259,200	825	6.55c	$1.74	26.6
1917	77	82,756.00	1,403,100	3,773	5.86	1.87	31.7
1920	109	152,497.00	2,799,500	5,255	5.89	2.45	45.0
1923	142	254,530.00	4,738,100	7,281	4.80	2.96	55.1
1926	173	352,942.00	8,505,684	9,459	4.15	3.22	77.7
1929	193	488,997.65	15,839,530	11,179	3.08	3.70	119.9
1932	213	590,994.43	20,297,499	12,593	2.91	3.91	134.3
1333	214	575,396.85	19,616,479	12,708	2.93	3.77	128.6
1934	214	582,132.97	20,411,374	12,756	2.85	3.80	133.3
1935	215	598,173.03	21,555,809	12,739	2.77	3.91	141.0

TABLE NO. VIII
All Municipalities Totalled
COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-Hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	43	$ 624,781.00	15,669,700	15,657	4.00c	$3.63	90.8
1917	123	860,475.00	31,983,500	27,453	2.69	2.77	103.1
1920	166	1,477,963.00	59,336,900	36,496	2.50	3.51	140.0
1923	206	2,613,257.00	105,482,600	46,383	2.46	4.80	195.6
1926	242	4,176,595.00	171,797,014	58,444	2.43	6.08	250.0
1929	273	5,893,217.25	272,343,330	70,106	2.16	7.11	328.6
1932	298	6,402,882.86	306,596,543	75,705	2.09	7.05	337.5
1933	300	6,149,792.11	292,335,489	75,443	2.10	6.79	322.9
1934	300	6,344,921.96	306,632,722	75,016	2.07	7.05	340.6
1935	302	6,601,461.02	327,413,421	74,884	2.02	7.35	364.3



1931 and 1935 was much higher than any previous year.

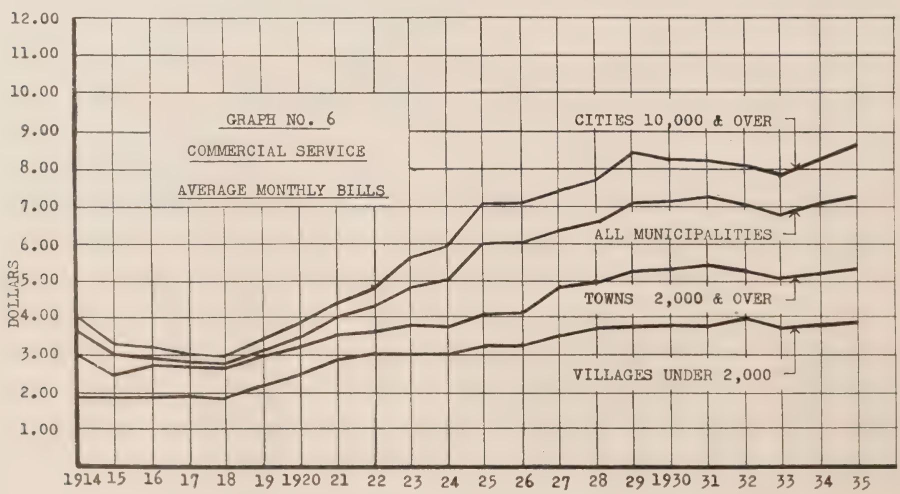
Table No. 6 gives similar data for towns over 2,000 population and the same general characteristics apply to this table as to the previous one, except that the increase carried on into 1932.

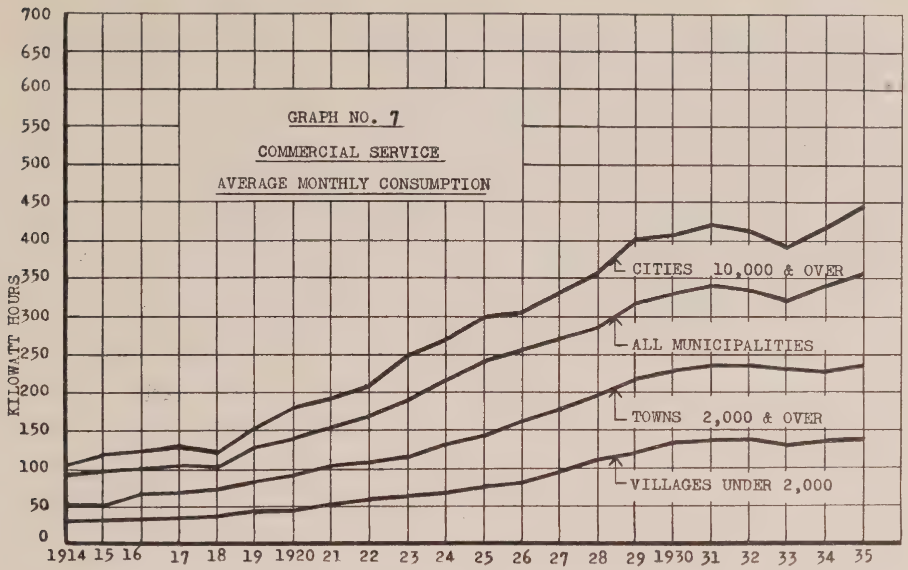
Again, in Table No. 7 for villages under 2,000 population the same facts in general apply as in Table No. 6.

In Table No. 8 we see the cumulative effect of the depression on commercial consumers. It is interesting indeed to see that up until 1932 both consumption and revenue increased, and it was only in 1933 that any decrease in either of these items showed itself, and 1934 recovered practically all lost ground with a big increase in 1935.

The figures on commercial lighting contained in these tables are also graphically illustrated in graphs Nos. 5, 6 and 7.

There is no yardstick by which the possible consumption among commer-





cial consumers can be measured or gauged, so that it is difficult to tell to what extent this field has yet to be developed. Suffice it to say that remarkable progress has been made in the past few years in the art of illumination and that the lighting installations of many commercial users are woefully inadequate to meet their needs, both for safety and health of employees.

The interest shown in the Lighting Schools and the demand for the advice of the lighting experts, and the numerous inquiries received by the lighting trade make it safe to say that a marked improvement in home lighting, store lighting, factory and office lighting will manifest itself with corresponding increase in domestic and commercial lighting consumption and revenue among Hydro users.

"—and Incidentally Electric Service"

THE August number of the *Edison Electric Institute Bulletin* contains an address by George M. Gadsby, President and General Manager of the Utah Power and Light Company, before the Annual Roundup of Engineers at the University of Utah, having the title shown above. This address looks at the problems of privately-owned electric utilities in the United States and particularly of the Utah Power and Light Company. The general question of electric service has many points that are common to both privately and publicly owned utilities and in extracting Mr. Gadsby's address we have endeavored to retain those parts that fit into the work of the Ontario Hydro ultilities.

The topic selected for this discussion has purposely been left with an open end antecedent; to the predicate title there will be affixed a group of subjects with a certain degree of continuity.

In order that you may know the objective to be attained, let me explain that the purpose will be to delineate the function of electric service, showing that electric energy *per se* is both the primary raw material used in producing a marketable product and at the same time this energy is worthless except as an agency in the performance of service. In order properly to evaluate the place of electricity in the broad field of industry let us have some background material.

While realizing that this audience is in large part comprised of engineers and students familiar with the proper definition of terms, I am going to recall the exact meaning of three words in the parlance of the electrical industry. First, Energy, which is the capacity for performing work. It may be potential in the form of water at an elevation or latent in the form of coal in the bins waiting to be burned under the boilers. In either event the worth of energy is measured, not in its own units, but in the value of its accomplishment when applied to productive work.

Power is the rate at which mechanical energy is exerted or work performed. Power is therefore one step further along the sequence of events which must occur in giving value to energy.

Service is a broad term covering the entire field of results after the application of energy through motion or heat. I know of no word carrying such an overload as service. One would think with the great number of words resting undisturbed in our dictionaries we might have a few more for use where needed, and I know of no instance greater than the desirability of separating the manifold meanings of this word, service, As used here, it will cover the final result and purpose of the generation,

transmission and distribution of electric energy. It is the only sales product of the electric company, and much of the confusion which has come about through intricate rate schedules and lack of public understanding arises from the difficult, if not impossible, attempt to measure service in units of kilowatt-hours.

Still in the field of background material, but advancing to the point of attaching the first subject to our predicate title, let us visualize the Structure of Business—and incidentally electric energy. The fabric of industry is comprised of a warp of certain primary and entirely self-sustaining types. These are agriculture, mining, including in this term all extraction of material from the earth's surface, construction, and manufacturing. Any one of these can proceed alone without ancillary service. The weft of the industrial fabric consists of service activities. The most important of these are transportation, communication and power. These latter types are entirely dependent upon the former, without them they cannot exist. None are self-supporting. Admittedly this is stripping the tapestry down to its foundation threads. Our modern complex society, with its great production units, could not continue in its present form without the close interweaving of warp and weft, but the fact remains the functions of communication, transportation and power are all incidental. Distribution and marketing are not entering into this discussion.

The purpose in emphasizing the ancillary position of electric power is not the result of an inferiority complex, but because of the need of recognizing the relative importance of many factors which comprise industry.

In the recent past there have been loud and long proclamations about the need for cheap power and its almost sole responsibility for producing the abundant life. Admittedly the lower the cost of any raw material or any part in the process of production the lower may be the price of the finished product going to the consuming public. Admitted further is the desirability of price reductions when brought about by efficiency and not at destructive cost either to labor or legitimate profit. In the ordinary industrial operations the cost of power is scarcely enough to affect the selling price of the manufactured article in the second decimal place. Electric service is in a highly competitive market and its price for industrial uses is sharply limited by the cost of producing power by other means. With a few notable exceptions, such as electrolytic and electrochemical plants, the offer of absolutely free power would not much affect the establishment, growth or migration of industry.

A few years ago some very careful studies were made along this line and it was found that the ranking reasons for all industrial gains in the various locations of the United States are, in the order of their importance, as follows:

1. Proximity to market.
2. Labor conditions.

3. Cost of transportation of raw materials and finished product.
4. Availability of materials.
5. Available factory building and site.
6. Personal reasons.
7. Cost of power and fuel.
8. Cost of land.
9. Grouping of related industries.
10. Living conditions.
11. Financial aid.
12. Taxes.

For years probably the cheapest source of reliable power on this continent has been Niagara Falls, and yet the territory adjacent to the Falls has shown no phenomenal growth. The automobile industry came long after the establishment of those great hydro plants, but it went to the area centering in Detroit. The rubber industry went to Akron. The brass industry stayed in New England. The migration of the textile industry was not from New England to a cheaper source of power, but from New England to the south, where it was closer to the raw material and a cheaper source of labor.

Perhaps if a list of industrial influences were to be prepared today, near the top would come the attitude of the state or community toward its existing industries as demonstrated by the record on taxation, legislative regulation, local patronage and general fairness reflected in a sympathetic understanding. The doctrine of confiscation and unequal distribution of taxation will bar industrial growth to an extent that could not be overcome if you were to furnish free power and even put a bounty on its use.

Eighty per cent. of plant locations are determined by private investigation and independent surveys. Fifteen per cent. are influenced by community advertising and activities of civic organizations. The remaining 5 per cent. are due to personal and miscellaneous reasons.

The important things to be done by any state or community desiring new industries is to establish and maintain its character for fairness, sanity and appreciation of its existing enterprises. Such a reputation will be a foundation which will be attractive to new concerns and promote the growth of those already under way.

Industries are not brought in, they come in when conditions are inviting.

Certain of our primary activities are of necessity limited in their location. Agriculture, while widespread, is of varied character and is determined by climate, soil, water and marketing conditions. Mining is determined by location of deposits. Construction follows industrial development, and only the fabrication of materials and manufacture is really foot-loose and capable of selective choice in location. In ordinary manufacturing power costs seldom exceed 5 per cent., and probably average nearer 2 per cent. The reliability of service and flexibility of capacity to meet the varying needs in the industrial plant are of far greater importance than its actual cost. To illustrate, a variation of 3 cents a bushel for wheat will wipe out the entire power cost of producing a barrel of flour. Just

the increase in the annual cost of foods between March, 1933, and March, 1935, has been five times the 1935 residential and farm electric bill for the entire nation. The deficit in our federal budget for any one year, between 1934 and 1937, would pay one and a half times for every kilowatt-hour of electric energy used for every purpose of every kind and character in the United States.

It has already been stated that electric energy as, of and by itself, is not a marketable thing. It has neither form nor substance, weight nor magnitude. It is simply an agency convenient for the transfer of a type of energy into the production of work by light, heat, motion, or electrolytic action. What people really buy is the accomplishment of the manifold tasks of electricity.

After the conversion of the falling water or the heat content of coal into electricity at the power generating station the process of creating a marketable product has but begun.

Much argument has raged about the spread between or cost of a kilowatt-hour at the power plant and the selling price of a kilowatt-hour delivered at the consumer's meter.

The average price received from ultimate consumers in U.S.A. per kilowatt-hour delivered at their meters in 1935 was just under 2½ cents. No national data are available for average production cost, but it would not be less than 3 mills, or a spread of about 1 to 8 from raw material at the mill to finished product wrapped up and delivered inside the door, just as required, day and night through 8,760 hours of the year.

Rough sawn lumber at the mill costs $20 per M board feet. Converted into a six-room frame house ready for occupancy the same lumber is worth $400 per M, a 1 to 20 spread. A walnut log at the mill costs about $135 per M, but when you buy it as walnut veneer furniture you will pay at the rate of $17,500 per M, a spread of 1 to 130. Yet in each instance a raw ingredient has had much labor, skill, investment, and refinement added to make it into a useful thing and bring it to the user.

For years we have devised rate schedules incomprehensible to the public and really understood only by the rate experts of the Power Company. We have talked in our own language and tried to educate a public which has troubles of its own. Only recently have we come to a realization that we must offer the public our services translated into the language it understands, at the same time endeavoring to simplify our rates to the greatest possible degree. Most people have occasion to think only in terms of commodities, and perhaps in no other major industry does there exist the same difficulty of interpretation as there is in attempting to think of washing and ironing in terms of kilowatts, volts and amperes. If you say a kilowatt-hour may be purchased for 10 cents or for 5 mills, it registers nothing to the ordinary purchaser, because that purchaser has no way to convert a kilowatt-hour of energy into so many equivalent pounds of

ice, or so many lumps of coal, or so many hours of sweeping and dusting. On the other hand, if we can fix a reasonably accurate price at which these services may be performed by electricity for a period of a month, we then approach the customer in understandable terms. This change in policy is having effect and the old idea of the "Electric Light Bill" is gradually passing.

The present day monthly bill of the electric service company is a rather interesting package of diverse contents. To begin with, it includes a wide variety of service having nothing to do with lighting. It is the cost of sweeping, laundry, including both washing and ironing, food preservation and food cooking, the manufacture of ice cubes of equal serviceability whether mixed in the glass the night before or applied in the ice cap the morning after; more and better lighting, of course, comes in the package with its saving of eyestrain and bodily fatigue; water heating with all its manifold uses and now air-conditioning are becoming more frequent articles in the package.

The present efficient and convenient apparatus for the use of electricity has not come upon the markets full blown in its beauty and usefulness. Many years of work have been required and many more years have been devoted to the development of public acceptance of these appliances. The power companies have played a leading part in extending the field and bringing to their present state of perfection, or even imperfection, the electric refrigerator, the bright and shining range, and the drudgery-eliminating water system and utility motors on the farm. It is true these appliances have brought about wider use and in turn wider use has made possible lower rates. None the less, in the electric service package there is the development and promotion of the electric appliance. In recent years the utilities have been among the leaders in accident prevention and safety first training. A majority of the employees receive first-aid instruction and many cases are of record in which lives have been saved by the appearance on the scene of accidents of skilled men and women who have received their training on time paid for by the electric company. It may not be fair to say that there is a cost element in this because statistics prove the direct saving to the company exceeds the cash outlay for this work, none the less it is a component part of the package and whether you realize it or not you are under some measure of protection by reasons of the training of these employees.

Dreams of the Future

By Dr. Willis R. Whitney, Vice-President in Charge of Research, General Electric Company

ONLY a few years before Schenectady was settled, an Englishman more broadly educated, studious, experienced, unselfish, and more matured in economics than any of us, fully realized that inquiry into the secrets of Nature might forever endow people with new processes and products. He wrote many papers and books on inquisitive living and on possibilities which would reward the seekers. And, though he did not know how to make it come true, he pictured greatly improved living. Exactly as with us, nobody cared to read his stuff. They preferred, as people still do, to drift with the crowd. So long as no one far outdistanced the rest, there need be no worry. They had always muddled along. This is still a British battle-cry. Apparently we inherit 90 per cent. of our complacency.

I still feel great respect for my English idol, Bacon. No one else sees him as I do. He may well have written Shakespeare and carried on his other jobs, for he was that sort of worker. The duties of Attorney-General for Great Britain, or Keeper of the Royal Seal, or Lord Chancellor, all of which he assumed in turn during the active times of Queen Elizabeth and James I, were part of the preparation forcing him to write about the importance of scientific research. It is futile to attempt any summation of his ideas. Little, short of the whole plan, could tell his story. He said, in his advocacy of research, that he "stood alone in an experiment too bold and astounding to obtain credit." He wanted experimental work, not discussions. So do we. He even wrote: "Axioms determined in argument can never assist in the discovery of new effects: for the subtilty of Nature is vastly superior to that of argument." (Three hundred years have clearly confirmed his view of the "subtilty" of Nature. It grows more fine-structured and flexible every day). He repeats this in a hundred ways. You may read it in the *Advancement of Learning* of 1605, which certainly repelled those he wanted to help, and in the *Novum Organum* (fifteen years later) in which he puts it more clearly. Yet, after 50 years of consistent effort, he could not make a dent in any mind but his own. Then, probably discouraged, he tried the world's first experiment in the popularization of science. He spun a yarn *The New Atlantis* — an island story. This he filled with views of the future. (Just what I was asked to do for *this** island. He had been on his job much longer than I have on mine, and had been in close touch with politics, government, economics, literature, and a varied lot of broad-

* This aludes to Association Island, where the original of this article was given as an address to engineers and officials assembled in a General Electric camp.—Editor, *General Electric Review*.

ening activities. If anyone could prophecy, he might. But his prophecy was not published until after he died, and mine can't wait. Bacon told the folks of 1625 of the inventions some ship-wrecked sailors found on an imaginary island. Most of these dreams have since come true.

But it took 40 years of public incubation, in addition to his own half-century of action, to force anyone to start what he planned so plainly. By 1660 things were moving a little. A small research group of the best scientists got together, and thus was started the Royal Society of Great Britain, and later also the Royal Institution. Subsequent pioneers, like Newton, Darwin, Faraday, Maxwell, Raleigh, Dewar, and Bragg, finally were born from that beginning. We ourselves make daily use of principles and products found by these men. From Benjamin Franklin, who, in imitation, established the American Philosophical Society, to Harvard University's Eliot, we are distinctly beholden to Bacon's ideas. He speaks of our "setting out from what is constant, eternal, and universal in Nature and opening such broad paths to human power as the thoughts of man can in the present state of things scarcely comprehend". It was a big job. And yet, correct as he was in his fundamental ideas, Bacon found great difficulty in merely naming a score of things to come. We may thus learn that it is impossible to rob the safe of Nature, though the combination is printed on the door.

Bacon tried to foresee future gadgets, but, of course he had no eye for the invisible. He could extend his hand only the length of his arm. If he used a club, it was for hitting things that bumped into him. He thought it would be a grand novelty to have folks travel in carriages without horses, sail without sails, and go under water; fly somewhat like birds, be cured by salt baths, and drink sea water from which the salt had been filtered. This last is almost the only prediction of his that is not quite realized yet. Our advertisers and makers of air-conditioning apparatus should take off their hats to him, because he wrote, "We have also certain chambers which we call chambers of health, where we qualify the air as we think good and proper, for the cure of divers diseases and preservation of health". There is nothing new under the sun but discovery of the fact. And listen to this: "We have also great and spacious houses where we imitate and demonstrate meteors." Here is the Hayden Planetarium recently built in New York after 300 years of waiting. And this, "We make plants also by art and greater much than their nature and their fruit greater and sweeter and of different taste, likewise divers new plants differing from the vulgar". This was all written centuries before Mendel disclosed the principles of plant heredity, Burbank produced his varieties, and our great electrical company "monkeyed" with the Easter lily, made in non-dehiscent, and got a patent on it.

To indicate that such scientific research had preceded these Baconian discoveries, he speaks of serpents, worms, etc., made from "putrefaction", and says, "Some are advanced in effect to be perfect creatures and

have sexes and do propagate". This at a time when people believed frogs and worms were sexless and merely rained down from heaven—as they still seem to do. But he wrote, "Neither do we do this by chance but we know beforehand, of what matter and commixture, what kind of those creatures will arise." Microscopes for such fine detective work as Bacon described were first produced by Leeuwenhoek about 40 years later, and he it was who then showed that gall flies, maggots, worms, etc., really came from eggs instead of raining down or being produced by putrefaction.

The loudspeaker was also mentioned by Bacon, for he described it as "an artificial echo which gives back the voice louder than it came". I wonder, too, what he meant by saying the islanders had ways of conveying sound in "strange lines and distances". We use telephone lines ourselves. But in all this, you see, he scarcely left his own mental hearthstone. He was powerless to wish for anything disconnected with what he already knew. Had he said, "Experiment right and you will talk around the world", his mind would have wrestled with some unbearably long speaking tube. His shipwrecked sailor said that the people of Salomon's house could fly a little but he added, "like the birds". Really, we can't fly that way yet. But, fortunately, for his general predictions, experimenting by inquisitive wild men, as we call them, disclosed ways of suitably corking and uncorking iron bottles of burning explosives, and so we got gas engines. This was too remote a thing for Bacon to anticipate. Sunlight motors might have seemed easier.

There may be things that are impossible, like prediction and clairvoyance. But new discovery will never be impossible. Almost everything conceivable can be done in that way. Moreover, no end of inconceivables will still be done, and explained afterwards. The increasing "subtilty of Nature" cannot be photographed, but there is a sure way to get it into history. Do it! That's practically what Bacon tried to teach. He could predict hot salt baths for rheumatism because within a hundred miles of London hot baths had been a comfort since Roman times. The city of Bath in his time was the best known spa in the world. He failed to record, however, even a vaguely defined vision of such devices as wireless, or talkies, or bicycles, or elevators, phonographs, x-rays, atoms, telegraph, electrons, primary batteries, transformers, photocells, steam engines, steam turbines, cotton gins, rubber, aluminum, rayon, tungsten, storage batteries, telephones, radio tubes, magnetism, chronometers, gyros, television, railroads, microscopes, bacteria, kerosene, gasoline, incandescent lamps, radium, sewing machines, dictaphones, photography, dynamos, motors, gas lighting, spinning machines, power looms, screw propellers, aniline dyes, bleaching powder, baking powder, and tooth powder, oxygen, spectra, nickel, manganese, cobalt, and chromium, anaesthetics, tin cans, umbrellas, Old Home weeks, fire engines, dish washers electric clocks, fountain pens, escalators, milking machines, etc.

I'm not belittling Bacon. I'm trying to excuse myself for not knowing enough to announce what to expect in the future. But without that knowledge, I can still tell you how to get it. Though if I do, probably you won't react any better than the intelligent gentry of Great Britain in 1625 did. They warmed up a little in 1661. It's funny too that when they did move, it was not the digestion of the tough meat and healthy malt of *Novum Organum* that started them, but the little popularization yarn about Salomon's house. This reached down to a few good men who said, "While we can't undertake such organizing as Bacon describes in this impossible prospectus, we might start a tiny sample for test". This is now the British Royal Society. This all reminds one of the truth which our modern advertisers have learned. A thing itself, infinite, exact, simple, invaluable, undecorated and truthful, does not sell at all—it has to be sold. The short little fable called *New Atlantis*, written for simpletons and illustrated with funny pictures, made the leading thinkers of England "buy it on the installment plan". They are still paying on it.

How can I prophesy? No prophet could predict millions of dollars of business to a lamp company for making bulbs to produce invisible light. But it came! X-ray tubes were not contiguities of incandescent lamps, but they lit up our bones. No prophet would advocate fevers to cure the sick, nor predict that the building of equipment for this "unnatural" purpose would develop into an active business. All one can predict is that if we are sufficiently inquisitive we may find what we didn't anticipate, and some of the things will be wanted. A few years ago I would have predicted the continued extension of street cars to the alleys of every town. But now they are rapidly passing out. So I know now that the grand goal of good gadgets is gradual obsolescence, or, expressed differently, we may get better every day. This is merely a restatement of Claude Bernard's words, "The goal of all life is death". Nevertheless, the interesting processes of life will still go on and forever change. Baron Munchausen was as perfect a prophet as anyone can be. He froze sounds in a bugle which could later be thawed out, thus anticipating the phonograph. Would anyone anticipate that electric motors passing from highways, would "hide away" in boxes in our kitchens? That they would there cook and cool food, and suck oranges; and that Bacon's attempt to preserve raw flesh by snow, which led to his death by pneumonia, would prove the forerunner to electric refrigeration?

You may say these things are not logical. But of course they are. The one thing we can be sure of is the unalterable fixity of the laws of change, even if we are seemingly stupid in their appreciation. We call discoveries accidents, just because we don't know enough to anticipate them, but they always occur regularly and in accordance with the same old laws. If it weren't so terribly serious, it would be excruciatingly funny. Each one of us in the electrical business is in intimate contact with a most valuable new environment. No two peo-

ple are alike, nor any two environments. We strain our eyes for some other horizon and stumble over what seems an obstruction, some engineering complaint, some defect. This obstruction is the only thing on which our real usefulness can possibly work. Therefore all of us, particularly the youngest, are in rare world-positions. Things on every side are changing, and if we aren't also conformably and constructively changing, our lamp may be already out.

Good local prophets are now predicting sodium highway lighting, extending from pole to pole in all directions. We made such lamps in 1912. But someone may fool us yet by putting what the scientists call "phosphors" into the cement of our roadways to collect and store cheap daylight and feed it back at night. This would render electric lighting unnecessary. For over a quarter-century we have kept researches going on some part of the Calrod hot plate. All steps taken were quite logical after each surprising discovery, but now we are almost forced to consider cooking by radio rather than by heat convection, things change so fast. As I said before, it just isn't possible to predict the new things, but it is elemental obviousness itself that additions to what we know will bring about what no one can possibly predict.

I recently ran across a defect in Max Nordau, who, incidentally, correctly said: "Discoveries follow an iron law of logical succession". But he incorporated an error when he wrote: "Since the physical and psychic organism will not alter within a measurable distance of time, its behaviour will always conform to those same laws that have regulated it in the course of its history." I think the premise is an error. Physical and psychic organisms will continually alter, just because new research is being applied to those very fields. We build our cerebral cortex. It's the greatest indoor sport. No one can prove that our behavior will always be as bad as it is now. Naturally science may seem to us practically complete. There may appear little to do but refine the products. Some scientists have stopped there, but subsequent facts have always proved them wrong. My own German professor was in that class. Great knowledge sometimes becomes so dominant that it obstructs the view of the future; the main use of the known is to aid, not *fix*, imaginative flight.

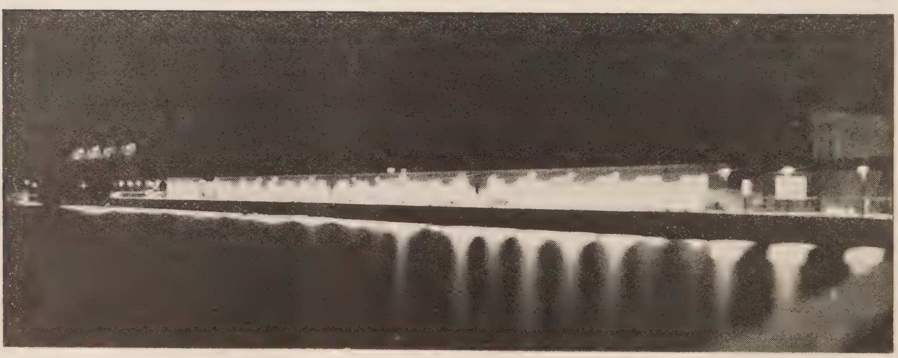
The only use for the word "progress", according to Max Nordau, is to cover changes in "science". The progress of the world is a misnomer because there can be no progress of a thing that is already eternal. Some men might be allowed to progress, but Nordau tries to prove this wrong because there is a peak to the process in man. He has at least to retrogress in old age; no one can determine what part was purely the upward process. Perhaps the child, being care-free and happy, has progressed to the limit. But to Nordau at least "technical invention" is something real and has "progress". This is illustrated by many examples. I take only one series: club, stone-axe, flint-arrowhead, sling, rifle, cannon, torpedo,

cruiser, and armored battleship. Arbitrarily, that is progress. I myself prefer to see "progress" applied to new knowledge regardless of technical applications. We make no gadget to correspond to some of our new truth. But all about us in our work as engineers, researchers, advertisers, salesmen, or what not, there is a specific local zone in which we alone cultivate, or neglect, our individuality. If we will only add to special knowledge we may trust results to the well established laws of progress.

I have tried to dream of the future as requested. I like to look ahead because I've been elevated so much in the past. But even if I could see the future, I couldn't describe much of it. Necessary words for new things are only invented later. Also I prefer Nature's method. She says, "Go and get it. It's all there. But don't expect to dream just what and where it is".

See how flat it sounds when I tell you my dreams of future men who are fully matured at ten years of age. Thymus-gland research on rats promises this. It is only a step in modern surgery to cut out our worries and even cure criminals, by means of a tiny electric brain scalpel. Neurolectomy is pointing that way. Our long-staple cotton may be replaced by an incombustible fabric made from scrap bottle-glass. But why scare the cotton states with prediction! The present is bad enough. We haven't learned how to transmit power from the coal mine. That may depend only on a new radio-focusing gadget, but who wants to describe it now? Such dreams are distinctly uninteresting because they lack the essential of news value—fact.

When I stop dreaming and consider the past which I have seen, it becomes continually clearer that we can never reach a limit of discovery while we work. Each new item of our electrical past has opened still more fertile areas in the unknown. Our industry began in a vacuum lamp, it spread to power generation and now reaches into countless lines (and provides many new lines) of human interest. We need never reach a time when the future of electricity can be bounded even in dreams, if we will only keep sufficiently awake.—*General Electric Review.*



The Phases of Venus

THE people of early days, particularly the Greeks, knew an exceptionally bright morning star which some called "Phosphorus", while others named it "Lucifer". They also knew an equally brilliant evening star which they called "Hesperus". These stars were not in the sky in the same seasons and, undoubtedly, there was considerable speculation as to where one had gone when the other appeared. After several centuries, however, it was at last realized that these two stars were one and the same planet, which is now known as Venus, named for the Goddess of Beauty and Love.

Venus is about the same size as the earth and revolves around the sun, in approximately 225 days, on an orbit having a diameter about seventy per cent. of that of the earth's orbit. The planet appears to be covered with a uniform layer of condensed steam which reflects about sixty per cent. of the sun's light and, when at greatest brilliancy, Venus is the brightest star-like object in the heavens. The reflected light, too, is remarkably white and steady.

Since the orbit is smaller than that of the earth, the planet never appears in the midnight sky. In fact, its maximum angle east or west from the sun is about forty-eight degrees so, as a "morning star," Venus cannot rise much earlier than three hours before the sun and, as an "evening star", it must set not much later than three hours after the sun.

In travelling around its orbit, Venus, as seen from the earth, passes through all phases like the moon,—but in the reverse order. In this cycle this planet's apparent diameter changes by the large ratio of more than six to one, in accordance with its varying distance from the earth. This is a much greater change than is found in the moon, or with any other planet.

The diagram of Fig. 1 considers the earth and sun to be stationary and shows the travels of Venus around the sun and relative to the earth while moving between positions X and Y as an evening star, and further into the morning sky. Fig. 2 shows the phases of the planet and its comparative sizes corresponding to certain positions given in Fig. 1.

On June 29th last, Venus was at the point X,—it crossed the meridian with the sun. The planet then was beyond the sun so this was known as the "superior conjunction", at which time Venus, even though "full", could not be seen from the earth for it was too nearly in line with the sun and was overcome by the latter's brightness. A few weeks later, the planet had moved to a point A. It could now be seen, appearing still full, or very nearly so, and of minimum size, Fig. 2.

As Venus continues to move toward Y, the illuminated area, visible from the earth, is gradually growing less but the planet is coming closer

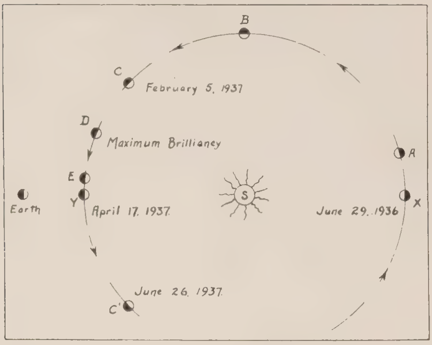


Fig. 1—Relative positions of Venus on its orbit, the earth being considered stationary for reference.

X — Superior Conjunction, June 29th, 1936: planet not visible.

A — Planet first visible as evening star: nearly full phase.

B — Mid position between conjunctions: gibbous phase.

C — Greatest Elongation East, February 5th, 1937: half phase.

D — Maximum brilliancy: decrescent phase.

E — Planet last visible as evening star: thin decrescent phase.

Y — Inferior Conjunction, April 17th, 1937: planet invisible.

C′— Greatest Elongation West, June 26th, 1937: half phase as morning star.

to the earth. For a time, the decrease in distance more than offsets the reduction in visible area so that there is an increase in apparent brightness.

From X to C, Venus passes through the "gibbous" phase,—the word meaning "bulged on one side,"—and when at B, appears as shown in Fig. 2, larger than when at A but definitely not spherical. On February 5th, 1937, the planet will have reached the point C—"greatest elongation east",—where it appears as a half moon at greatest angular distance east from the sun. It is still growing larger in apparent diameter and brighter, but will reach its maximum brilliancy about one month later, at the point D when it will be clearly visible to the unaided eye an hour or more before sunset.

From C to Y, Venus is in the decrescent phase but after passing D, the rapidly reducing area is no longer compensated by the changes in distance from the earth. The decrescent therefore becomes thinner and less bright until finally it is lost to view at a point about E where the background sky, near the sun, is well illuminated. Venus disappears at its maximum apparent size.

On April 17th, 1937, this planet again will cross the meridian with the sun, but as it is now nearer than the sun, this is called an "inferior conjunction". Due to the inclination of the orbit 3°—24′, the planet usually is somewhat north or south of the sun at such times.

Following this date, Venus becomes a morning star and passes through crescent phases to be at the point C′, on June 26th, 1937,—"greatest elongation west",—where it is again a half moon and at maximum angular distance from the sun but west of it. Then the planet goes through the gibbous phases to the next superior conjunction, on February 4th, 1938, after which it again becomes the evening star. The time taken from any given phase position through the cycle to the same phase again,—the synodic period,—is approximately 584 days, during which

A B C D E

Fig. 2—The Phases of Venus, as an evening star, and its relative apparent sizes, corresponding to positions shown in Fig. 1:—left to right.

A — Nearly full: at minimum size.
B — Gibbous: December 7th, 1936.
C — Half moon. February 5th, 1937.
D — Maximum brilliancy. March 12th, 1937.
E — Thin decrescent—nearly maximum size.

period Venus and the earth make respectively 2.6 and 1.6 revolutions around the sun.

The following table gives the dates for the four important positions of Venus during a nine-year period:—

THE PHASES OF VENUS

X Superior Conjunction	C Greatest Elongation East —Evening Star—	Y Inferior Conjunction	C′ Greatest Elongation West —Morning Star—
Nov. 18, 1934	June 30, 1935	Sept. 8, 1935	Nov. 19, 1935
June 29, 1936	Feb. 5, 1937	April 17, 1937	June 26, 1937
Feb. 4, 1938	Sept. 11, 1938	Nov. 20, 1938	Jan. 30, 1939
Sept. 5, 1939	April 17, 1940	June 26, 1940	Sept. 3, 1940
April 19, 1941	Nov. 23, 1941	Feb. 2, 1942	April 13, 1942
Nov. 16, 1942	June 28, 1943	Sept. 5, 1943	Nov. 16, 1943

On very rare occasions, Venus stages a special feature,—the planet crosses the disc of the sun at certain inferior conjunctions. It then appears as a small round black dot against the glaring background and may take as long as eight hours to complete the crossing.

The last occurrence of a "transit of Venus", as this phenomenon is known, was on December 8th, 1882, and there were many observers who

now clearly remember it. The next transits will occur on June 8th, 2004, and June 6th, 2012.

These "transits" can take place only in the months of June and December. They are occurring in pairs, the components of each pair being 8 years apart and the pairs being spaced at approximately 115-year intervals.

Venus is now in the evening sky, but its phases cannot be followed without a telescope of fair power, although, when the planet is between D and E, a thin decrescent, its form may sometimes be seen through a low power surveyor's transit, and it has been reported that with special conditions of light and cloud, the thin crescent has even been observed with the unaided eye when the planet was in the morning sky.

Venus has no satellites, rings, or other appendages, and no permanent markings appear on its cloud-covered surface, but with its brilliant whiteness and its interesting series of phases, this planet is well named after the Goddess of Beauty.

—*F. K. D.*

Lineman's Son Saves a Life

On March 18th, 1936, a man in East York went out to his garage and some time after his wife became worried at his absence and went to the garage. On opening the garage door, she screamed. Two boys were in the next yard and climbed over the fence to see what was the matter.

On going into the garage, they found the man slumped beside the car, unconscious and not breathing. After dragging the man to the door of the garage and shutting off the motor, one boy ran for help and Val Bennett started artificial respiration. It was some minutes before he had the man breathing and then help came from the Fire Department and doctors.

Val Bennett is the son of C. W. Bennett, a lineman of East York Public Utilities Commission and had been taught the standard technique of the Prone Pressure Method of Artificial Respiration, by his father.

At a regular meeting held by the Electrical Employers Association of

Val Bennett.

National Safety Council Medal.

Ontario, on September 10th, 1936, in Veterans Hall, Kingston Road, Scarborough, Val Bennett was presented with the President's Medal of the National Safety Council. There were present: George Wilkie, K.C., Chairman of the Workmen's Compensation Board, Members of the Commissions, Managers and staffs of the Public Utilities of Scarborough, East York, North York and Weston; the Reeves of Scarborough and East York. The Electrical Employers Association was represented by R. Harrison, Vice-President, Alph Hoover and H. L. Sanborn, members of the Board and Wills Maclachlan, Secretary-Treasurer and Engineer.

Resuscitation

While on an inspection tour with Mr. Dandeno, of the Patrol Stations between the Nipigon River and Port Arthur, I was asked by F. E. Littlefield, Patrolman at Dorion, to check over his boys Frank and Dennis in Prone Pressure Artificial Respiration.

Dennis and Frank Littlefield, sons of T. E. Littlefield, Dorion.

Mr. Littlefield has taught the boys resuscitation and has also taught other boys in the neighborhood. I found Frank and Dennis able to perform artificial respiration in a splendid manner and later asked them to pose for me in front of their home. One of the illustrations is from a photograph showing Dennis operating on Frank; the other is from a photograph of the boys.

There is no doubt that a number of the trained employees of the H.E.P.C. have, by teaching children artificial respiration, made it possible for them

Dennis and Frank Littlefield demonstrating Prone Pressure Artificial Respiration.

in an emergency to save the lives of others.

This practice is very much to be recommended and Mr. Littlefield is to be congratulated upon his initiative.—*Wills Maclachlan.*

The Effect of Lighting on Output

IN recent years, the Illumination Research Committee of the Department of Scientific and Industrial Research, in association with the Industrial Health Research Board of the Medical Research Council, has investigated the effects of illumination on the speed and accuracy of performance of industrial tasks. Earlier investigations having shown that improved outputs were obtained by better lighting in connection with such fine work as typesetting by hand, it was decided to extend the investigations to the other extreme of rough work. The work chosen for test was tile pressing, and an account of the results obtained are contained in a report, entitled "The Effect of Lighting on Efficiency in Rough Work (Tile Pressing)," prepared by Mr. S. Adams, and published by the Stationery Office at 4d. net. The work proved conclusively that on continuous work, the use of low rates of illumination is likely to result in losses greater than the additional cost of improved lighting.

The first set of tests, six months in duration, were carried out in a tile-pressing shop which was below the ground level and received less than the normal supply of daylight. It was hence easily possible to increase the

amount of illumination on the work in stages. Originally, the lamps used gave 1.75 foot-candles at the presses and 0.5 foot-candles at the centre of the shop. Tests under these conditions were made of the outputs of certain workers over a period of eight weeks. Higher candle-powered lamps were then introduced, and the illumination increased to 4.7 foot-candles at the presses and 2.4 foot-candles at the centre of the shop. Observations under these conditions showed an average increase of output of all operatives of 5.73 per cent. A further change was made to 6.6 foot-candles at the presses and 3.0 foot-candles at the middle of the works, but no further improvement in output was found. It is suggested, however, that in this case there was a disturbance factor due to the impending change over to a new works. In the new shop, with no artificial lighting, as the amount of daylight entering during working hours was ample, the average output per man, using the same individuals as subjects, was increased by 11.96 per cent. It is claimed that the results obtained showed that it is desirable to have an average illumination of at least 3.0 foot-candles if a high standard of efficiency is demanded, and the work is of a nature that depends little on the visual capacities of the workers. Since the cost of lighting frequently does not exceed 1 per cent. of the pay roll, the increased illumination appears to be more than justified on economic grounds, quite apart from any satisfaction that it affords the workers.

In the second investigation, observations covering three years were carried out in a factory making roofing tiles. The operatives, females in this case, worked hand fly presses. Each press had a gang of three workers, the first collected the soft-clay sections and put them near the press, the second put them into the die and rotated the handle above the press. After the second girl had opened the press, the third, on the opposite side, punched two holes in the tile by means of a foot-controlled punching machine. The tiles were then stacked, after being taken away by the first girl, at the drying station.

In the pre-experimental period, 60-watt clear lamps were used. They were very dirty and the reflectors were of old type. The experiments were made with 40-watt, 60-watt, 75-watt, and 100-watt pearl gas-filled lamps, and with 150-watt clear gas-filled lamps. Taking the output with 60-watt clear lamps with old-style reflectors as a standard, the improvements shown with 40-watt pearl lamps and modern industrial reflectors, replacing the old equipment, was 5.9 per cent.; with 60-watt pearl lamps, 8.08 per cent.; 75-watt pearl lamps, 10.46 per cent.; 100-watt pearl lamps, 8.12 per cent.; and 150-watt clear lamps, 10.66. Plotting the results on a base of foot-candles showed that the increase of output at 4 foot-candles was about 9 per cent., and was over 8 per cent. at 3 foot-candles. The results of these extended tests, coupled with the earlier ones, support the conclusion that an illumination of between 3.0 foot-candles and 4.0 foot-candles is desirable for rough work. The tests showed the fallaciousness of the belief that good lighting is unnecessary for work of this kind.—*Engineering*.

Lost Lagoon Fountain

THE Jubilee Fountain at Vancouver is situated in the centre of Lost Lagoon in Stanley Park, about 400 feet from the shore. It is octagonal in shape, the maximum width 38 feet, the central portion is 14 feet in width and rising 2 feet above the edge of the basin. The basin is supported on 52—25 ft. by 16 in. wooden piles and the weight of the water being approximately 67.5 tons. From the basin, jets and streams of water over 400 in number are directed upwards and inwards to provide individual vertical and dome shaped sprays. For the operation of the pumps two electric motors are used, one of 25 h.p. capacity and the other of 10 h.p. capacity.

The electrical equipment provides, first, the motive power for the pumps, and, secondly, both manual and automatic control for the lights and water effects. This control is unique in Canada as it is the first time that the new thermionic tube has been used to control such a variety of operations. Its intricacy may be imagined when the details listed below are studied.

There are 54 floodlights.

The total connected load for the lighting alone is 42 kilowatts.

The water effects and some of the lighting effects are controlled through a synchronous motor driven flasher, having two drums, the first with a period of 20 seconds for the lights on the main jet; and the second for a master control of the jet lights and also for the water effects with a period of 300 seconds.

Lost Lagoon Fountain.

The other lighting effects are controlled by a reactor dimming equipment which, in turn, is controlled by either a manual master control or a full automatic mobile light unit.

The master control unit consists of 9 potentiometers with necessary transfer switches. On the master control cabinet is also placed the necessary switches for operating the contactors controlling the pumps, floodlights and water effects. The automatic control unit consists of 8 motor operated potentiometers with a period of 360 seconds. The control circuit or movable

arm of the potentiometer is coupled to the grid of the tube and the tube units and so varies the ignition point. This corresponds to a variation of output current in the tube circuit which causes varying amounts of saturation in the saturable core reactors. This reflects a variable reactance in series with the lights and so causes them to dim or brighten as the potentiometer is operated.

A film type control is used to insure a definite predetermined programme which, in this case, consists of 3 sets of 8 films capable of giving two and a half billion effects.

The film itself is approximately the same size as a postcard size Kodak film to which is sewn a metal conducting braid in a predetermined pattern. The potential picked up by a conducting braid on the film passing under the potentiometer depends on the lateral position of the braid on the film. For instance, a straight run of braid along one side of the film will produce full intensity in the lighting circuit and if the braid gradually slopes toward the opposite side of the film, the lighting circuit is dimmed when that part of the braid passes under the potentiometer. The rate of change in intensity can be made gradual or rapid and thus the complete cycle is achieved in 360 seconds. Reserve films are kept to provide an altogether different cycle and change in programme.

The water jets are actuated by two motors, one a 25 h.p. and the other a 10 h.p., 3,450 rev. per min. motor, and these also are controlled automatically.

Contracts for the supply of the fountain were awarded to Hume and Rumble Limited, Vancouver, and the Canadian Westinghouse Company, Limited, provided all the electrical equipment and the hydraulic equipment except the pumps which were manufactured by Pumps & Power Limited, Vancouver.

Better Light—Better Business

The value of better lighting has again been proven by a barber in Strathroy. The old lighting was produced by drop lights, totalling 1365 watts. The new lighting was composed of two semi-indirect units with 500 watt lamps. The illumination intensity was increased from 15 to 40 ft. candles.

The shop was equipped with two chairs but only one was in use. The first month that the new lighting was in use the business increased $23.00. The proprietor expected that as soon as the novelty was worn off his business would return to its former level, but such has not been the case, the increased business remains and a second barber is to be employed.

It is not often that such a marked improvement in business can be produced by decreasing the wattage but the value of efficient and properly designed equipment is evident.

Mr. A. E. Ditchburn, manager of the Public Utilities Commission, was responsible for the change.—*G.G.C.*

First Electric Lights at the Exhibition

By Fred. Williams

FIFTY years ago to-day, on Sept. 11th, 1886, the Exhibition Grounds were for the first time illuminated by electricity, and, also for the first time, the grounds were open to the public after nightfall. It happened to be a Saturday and the day devoted to Labor (the statutory Labor Day on the first Monday in September did not come until 1892) and there was a big parade, owing largely to the fact that just at that time Canadian labor was feeling its feet; indeed, the first Dominion Trades and Labor Congress was formed a few days later.

It has been very difficult to procure any data concerning this first use of electric lights at the "Ex." I naturally thought that so important an event (as it turned out to be) would have been given considerable attention by the press; but a search through the files has shown that the editors, or reporters, of that period did not realize the potential importance of the new light. For instance, all that *The Mail* said was (at the close of a long report of the Labor demonstration):

"In the evening the grounds were lit by electricity and were open to the public after dark for the first time!"

From other sources I have gathered that in this first practical demonstration of electric lighting at the fair, produced by the Fuller Electric Light Company of New York, and the Ball Company of London, 100 arc lights and 125 "powerful incandescent lights" were used, producing "an unprecedented illumination" and causing spectators to "gasp with wonder at the manner in which the darkness of night was dissipated." Another feature of this historic evening was that the little electric railway (the first in America) operated from Strachan Avenue to the grounds, was equipped with an electric headlight and operated for the first time at night. It was, in truth, a night of electrical progress.

The real pioneer of electricity in Toronto was J. J. Wright, an Englishman. It was he, who, in co-operation with Howard Blezard, made the first generators in Canada, and he was the chief instrument in providing that little electric railway, produced by C. J. Van Depoule of Chicago. His initial plant was in the basement of the Firstbrook Box Company, on King Street east. But before him there had been others desirous of providing Toronto with electric lights. A year or so after Edison's invention in 1879, McConkey's restaurant, on King Street west, created great excitement by placing two arc lights in their establishment, and inviting the public to "come and see the light of the future"; but so little enthused were the citizens of that day that McConkey's had to advertise "free ice cream for all

those who inspect the lights." In May, 1881, R. H. Lunt, applied to the city council for leave to inaugurate electric lights in certain streets and was given permission to use the fire alarm poles temporarily, and he demonstrated the new light in the Golden Lion store (on whose site the King Edward Hotel now stands). He had competition when one Sperry from Chicago placed four arc lamps at the corners of King and Yonge to prove that he could give the city better service than could Lunt. Eventually the city council, on motion of Alderman Hallam, in October, 1881, appointed a committee to study the problem, with the final result that in 1883 the Toronto Electric Light Company, the creation of J. J. Wright, was given the contract to erect 50—2,000 candle power lights at street corners. But so conservative were certain elements that Alderman Moore moved that the two arc lights in the city council chamber should be removed, because the light was too glaring, and even proposed the abolition of the street lights.

But that is going into the story of the development of electricity in Toronto, which is too great a subject to be mixed up with the first electric lights at the Exhibition. Who then would have foreseen the thousands of lights which now make the fair grounds as bright as day, and brighter than some days? To-night the farmers and stockbreeders will be able to visit animal exhibits in lighted buildings. Half a century ago their grandfathers or fathers had to leave the grounds at sunset or use coal oil lanterns. What a contrast to the flood of light and power generated by Hydro at Niagara.—*The Mail and Empire.*

Botanical Gardens, Canadian National Exhibition.

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Toronto's Place in the Hydro System

By Hon. A. W. Roebuck, K.C., M.L.A., Attorney General and Hydro Commissioner

(*Address to The Electric Club of Toronto, October 7, 1936*)

THE first step in a consideration of the place which Toronto occupies in the Hydro system is necessarily some reference to Hydro as a whole. The Hydro systems of the Province are divided into six great divisions, each with its own separate assets and liabilities and its own independent operating account. Of these six great divisions, that which interests you most vitally is the Niagara System, for included in that System is the City of Toronto of which you are fortunate in being citizens.

Toronto's part in the Niagara System is not that of an independent unit. While there is an important division in the bookkeeping set-up and management between that portion of the Hydro whole which is owned and controlled by the Provincial Commission and that portion which is the property of the various municipalities, the fact remains that both financially and mechanically the Hydro system of the Niagara division is one indivisible unified machine. From the water reserves in the upper reaches of the rivers upon which generating plants are located, to the smallest electric bulb in the humblest kitchen, the Niagara Hydro is one complex organism.

I say this because I would impress upon you that Toronto cannot live apart electrically any more than she can live apart commercially. To be successful here one must be successful everywhere. The time may soon come when we will appeal to you for your sympathetic co-operation in carrying the benefits of electrical energy to the farthest outposts of our farming community, and at rates which will place its advantages within

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The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

the reach of the humblest of our agricultural citizens.

Now the important part which Toronto plays in the Niagara System may best be illustrated by a few figures.

The provincial portion of the Niagara System has fixed assets of $212,754,797.42.

The municipal portion of the Niagara System has fixed assets of $78,879,732.50.

Included in the municipal figure are the fixed assets of the City of Toronto amounting to $43,581,878.92.

It is thus to be observed that Toronto's capital investment is between 50 and 60 per cent. of the entire investment of all the municipalities within the Niagara division. It is between one-sixth and one-seventh of the total investment of both the provincial and municipal portions of the Niagara System.

In matters of revenue Toronto occupies an equally important position. For the year ending the 31st of December, 1935, Toronto collected from its consumers of electric energy the considerable sum of $12,757,884.98, while the total revenue of the other 172 municipalities of the Niagara System was only $14,341,790.88.

It may be well to point out, however, lest Toronto be unduly flattered, that the revenues of the provincial and municipal systems of the Province were last year $43,500,000.

The figures as to total investment and revenue may not perhaps convey as graphic an idea of the importance of the Toronto System as does the number of people served. For the year 1935 Toronto gave domestic service to 156,254 customers, nearly all of whom were heads of families. In addition to this the Toronto Commission served commercial light to 24,821 customers, and gave power service to 5,147 customers—a grand total of 186,222 customers. When one considers that the population of the City of Toronto is approximately 623,562, one can appreciate the importance of such a service which has on its books more than one quarter of the total population—men, women and children.

I mention these facts because I want to emphasize the part which Hydro plays in both the home life and commercial welfare of this city. Cheap and abundant light is almost essential to civilization itself. Dark and dingy premises belong to the ignorance and squalor of ages gone by, while adequate illumination is part and parcel

of the happiness and enlightenment of our own generation. Commercial light is essential to our business activity, while convenient power is an absolute necessity in a modern community which will hold its place in the world of production.

In the modern world where the success of industrial and business activity is dependent upon cost, the effectiveness with which these services are rendered is of the utmost importance.

It is not my intention to labor again the means whereby our power costs have been increased, or to indulge in unnecessary compliments to the Provincial Hydro Commission for betterments since we took office, but perhaps I will be permitted to say something about power costs during the past few years.

The actual charge for power made from year to year by the Provincial Commission as against the municipalities of the Niagara System during the last ten years has not varied greatly. The lowest charge, that of 1929, was $24.17 per h.p., and the highest charge, that of 1933, was $26.59 per h.p., but this uniformity was secured at tremendous cost to the Provincial finance and your rates have been stabilized as well at the expense of the municipal system. For instance, in 1932 the Provincial Commission charged the City of Toronto $25.85 per h.p., and the actual cost of the power supplied was $30.12 per h.p. That is to say, the Provincial Commission took from its reserves the sum of $4.27 for every h.p. which it sold to Toronto. In 1933 the Provincial Commission charged $26.59 per h.p. to Toronto, but the cost was $33.95 per h.p. In 1934 we charged $26.13 and the cost was $30.85. In 1935 we charged $26.43 and the cost was $31.00. During these four years we charged an average of $26.25 per h.p., but the average cost was $31.48 per h.p., and the Provincial Commission made an average loss of $5.23 on every h.p. which it sold to the City of Toronto, and we drew down from the Commission's reserves an average of over $3,000,000 per year to cover the losses of the business done with the City of Toronto and other municipalities of the Niagara System.

Nor is this the only loss. During the same period, the City of Toronto drew from its own reserves for the stabilization of rates the sum of $673,516.53.

It is on contemplation of these figures that one must consider the recent action of the Provincial Commission in lowering the interim rate to the City of Toronto by $2.50 per h.p. The Provincial Commission's resources for the meeting of deficits such as I have described, were at the first of this year practically exhausted. The contingency reserve which stood at one time at $14,631,725.88, was reduced to $3,780,000.00, and had the rate of loss been continued during the current year the entire fund would by now have been exhausted. The evil day of increased power costs might have been staved off for a short time by some other method of questionable finance but the inexorable facts were staring us in the face, of an increase in power charges to over $30.00 per h.p. per year.

Due to the cancellation of the Eastern power contracts, the picture has

drastically changed. The deficit has been abolished, and you have been notified, as well, that beginning Nov. 1st, 1936, there will be a reduction of $2.50 per h.p. from the present interim rate of $26.10 per h.p. per year. In other words, the Hydro Commission has in effect announced a reduction from a cost of $31.00 in 1935 to an interim rate of $23.60 per h.p. in 1937. But let it be observed that not only is the deficit eliminated in this interim budgeting, but the Commission is in 1936 setting up again the reserve fund which it formerly depleted, and will continue to do so in 1937. The cost of power in 1937 will, in fact, be less than $23.60, so that a sufficient balance will remain to enable the Commission to set aside for the purpose of contingency reserves at least one million dollars, together, of course, with the full amount of sinking fund and renewals provision. That $1,000,000 is the equivalent of approximately $1.50 per h.p. on the total power sales of the Provincial Commission to the municipalities.

In other words, the interim rate recently announced is $7.40 less than that which would have been charged in 1935 had all costs been handed on to the municipalities, and when one considers the reserves which are now being accumulated it is a betterment of approximately $9.00 per h.p. over the figures of 1936. And, gentlemen, the end is not yet. It is too early to prophesy with respect to the rates of 1938, but were I a member of the Toronto Industrial Commission, whose duty it is to advocate Toronto as a site for new industries, I think I would be safe in risking the prediction that the wholesale rate which the city will pay for power will be materially less in 1938 than it will be in the banner year of 1937.

Just what these figures mean to the City of Toronto may best be illustrated in gross amounts. Toronto had in 1935 a power consumption of approximately 257,000 h.p. Toronto's share in the Hydro Commission's betterment of $9.00 per h.p. amounts to some $2,250,000 a year. Forgetting for the moment the losses which were formerly included in connection with Toronto's power business, the actual reduction in rate from $26.10 per h.p. actual charge to the interim rate of $23.60 per h.p. represents an actual saving to the Toronto Commission of over $700,000 during the current year of 1937.

I have spoken with a pardonable pride with respect to the accomplishments of the last two years, and I look forward with a justifiable optimism to the progress that is yet to be accomplished, but while I do so, I think it is opportune to, at the same time, sound a note of warning.

Hydro has shaken itself free from the octopus that was draining its financial resources and ruining the service which it might otherwise render, but Hydro is by no means free of danger. Hydro last year paid taxes on its land assessment, and full taxation on its Hydro shops, according to law. We paid to municipalities in taxation the gross sum of $232,085, and we paid to the Provincial and Dominion Governments for water rights the sum of $722,842, a gross figure of $954,927. Hydro is prepared to continue these payments, but not to subject its entire

plant to municipal assessment. Were this brought about Hydro taxation would amount to something in the order of $12,000,000 per year, and cheap power in the Province of Ontario would be a thing of the past. There is no more justification for taxing the Hydro public service than there would be for levying taxes upon investments for the supply of water to our citizens, or upon street railways engaged in transporting citizens from place to place. If the power and light users of the Province are to be levied upon to fill the insatiable maw of municipal expenditures, cheap power for lighting homes and streets and business places, and for turning the wheels of industry is gone forever, and Toronto's commercial advantage is sacrificed for the benefit of the well-oiled spending machines of our municipal governments. The business men and home-owners of the City of Toronto should veto with unanimous accord every attempt at the entering wedge of Hydro servitude.

And there is another matter to which I should draw attention. Advancing years bring changed conditions and new problems. To those who founded and devised the Hydro system, municipal bankruptcy was a thing unknown, and in consequence, protection of Hydro interests in cases of municipal insolvency was neglected in the financial set-up. Money for the financing of municipal Hydro enterprise was raised by the sale of municipal bonds, and the money secured was advanced by the municipalities to the local commissions. Bankruptcy of municipalities has, in consequence, raised problems of great complexity and fraught with great danger. Hydro has never failed in a single instance to pay to the municipality both interest and retirement charges as they fell due, and yet we have witnessed a spectacle of compositions, involving Hydro in bankruptcy proceedings, and it is difficult to say how far municipal Hydro investments and reserves may be made liable for municipal defaults. The credit of the municipal Hydro systems has in consequence, been adversely affected.

It is not my intention to discuss at the present time the condition of the law as it stands, or to refer to the particular incidents which are now in course of settlement, but I do suggest to you that just as Provincial Hydro has now grown sufficiently strong to stand on its own feet, and Hydro is issuing its own bonds, guaranteed by the Government, and its assets are distinct from Government assets, so too the future financing of the municipal commissions should be accomplished by the issue of the municipal commissions' own bonds, guaranteed if you will by the municipality, and municipal Hydro assets should be held distinct from the assets proper of the municipalities. Hydro solvency should be assured in all cases to Hydro investors, and Hydro assets should be out of jeopardy in event of financial entanglements in which municipal councils may be involved. No Hydro commission, provincial or municipal has ever defaulted on a single dollar of its interest or principal obligations, and in all likelihood never will, and it is only in this way that the benefits of Hydro's enviable record can be maintained.

Power Supply in Northern Ontario Mining Districts

By T. C. James, Assistant Engineer, H.E.P.C. of Ont.

POWER supply is always a vital factor in any form of industrial development and especially is cheap power absolutely essential to successfully conduct mining operations whenever or wherever such operations are of a major magnitude, and activities reach the production stage. In Northern Ontario, isolated mines, if transportation facilities are favourable, can carry on to a limited extent with power obtained from steam or diesel engine plants, but large properties located either in groups, or isolated districts, must have electric power for economical operation. Work on properties which are located in mining camps in remote sections has been carried on in almost every instance with steam or diesel engine power, and when the ore bodies have been definitely located and found to exist in sufficient quantities to warrant milling, contracts wherever possible, have been executed for a supply of electrical power, and where such was not available, production has been curtailed to small tonnage mills pending construction of new hydro-electric developments, or transmission lines from existing developments.

For a number of years after the discovery of the nickel, silver and gold ore deposits in Northern Ontario, hydro-electric power for mining purposes was obtained, either from developments owned outright by the mining companies, such as the High Falls, and Big Eddy plants of the International Nickel Co. on the Spanish River, and the Nairn and Wabagesic plants of the Mond Nickel Co. on the Vermilion River; or from local power companies with developments located adjacent to the various mining camps such as the Hound Chute and Fountain Fall plants on the Montreal River, and the Matabitchuan plant on the Matabitchuan River, of the Northern Ontario Light and Power Company, serving the Cobalt and Kirkland Lake camps; the Waiwaitin and Sandy Falls plants of the Northern Canada Power Company on the Mattagami River serving the Porcupine camp, and the Coniston, McVittie and Stinson plants of the Wahnapitae Power Company on the Wanapitei River serving the Sudbury camp. Since that date all of the hydro-electric developments on the Matabitchuan, Montreal and Mattagami Rivers have been inter-connected, and merged into a combination known as the Northern Ontario Power Company, which is a subsidiary of the Northern Canada Power Corporation. This company supplements the output of these power developments with a large

Coniston development, Sudbury district.

hydro-electric plant on the Quinze River in Quebec, and with purchased power from the Hydro-Electric Power Commission. This company is under contract to purchase all of its growth power for a ten-year period from the Hydro-Electric Power Commission.

The Wahnapitae Power Company's properties were acquired by the Hydro-Electric Power Commission in 1929 and with other developments purchased and constructed since that date, the Commission has now become the largest distributor of hydro-electric power in Northern Ontario. In addition to the Northern Canada Power Corporation and the Hydro-Electric Power Commission, the Great Lakes Power Company with its developments located on the St. Mary's River at Sault Ste. Marie, the Michipicoten River approximately 100 miles north of Sault Ste. Marie, and with a large development under construction on the Montreal River approximately 50 miles north of Sault Ste. Marie, is also in a position to supply large blocks of power to the mining industry. This company is at present supplying the requirements of the mining properties in the Michipicoten area, which is rapidly becoming an important mining camp.

It is a most interesting coincidence that nature, in providing a favourable geological structure for extensive mineral development in Northern Ontario, has likewise provided an abundance of water power sites adjacent to the various centres of mining activities on the various streams of Hudson Bay and Great Lakes Water Sheds with which to carry on the development of this vast mineral wealth. In a pamphlet published by the Ontario Department of Surveys in co-operation with the Dominion Water Power and Hydrometric Bureau in 1931, hereinafter referred to as the Surveyor General's 1931 report, a table is published showing the available and installed water power in Ontario, according to principal drainage basins.

McVittie power house and dam, Sudbury district.

Based on the estimated capacity in horsepower at 80 per cent. efficiency, at ordinary six months' flow, this table gives the total possible development on the various streams in Northern Ontario on the Hudson Bay, James Bay, Lake Winnipeg and Lake Superior drainage basins as 2,023,439 h.p. and the developed power for the same area as 822,535 h.p. The pamphlet points out that studies have indicated that throughout the country installed power is, in general, about 30 per cent. greater than the corresponding six months' flow would indicate, and on this basis, approximately 1,800,000 h.p. is available for further power development purposes in Northern Ontario, and developed power at the present time is approximately 31 per cent. of the total possible development. All of the developed power is, of course, not being utilized by the mining industry, as a large portion of same is taken up by pulp and paper mills and urban municipalities located throughout the district. A rough estimate of the probable amount of hydro-electric power utilized by the mining industry in Northern Ontario at the present time will approximate 150,000 h.p., and from the figures given above it is evident that there is ample power available in the undeveloped water power sites throughout the district to take care of future power requirements for the mining industry, irrespective of the amount of power required.

Due to the great distances between the urban centres and to the vast territory to be served, together with the fact that a number of individual hydro-electric power developments are required to serve isolated mining properties, it was found impracticable for the Commission to distribute power in Northern Ontario on a cost basis under the

Power Commission Act, in a similar manner to the plan which has been adopted in the southern parts of the province where the activities of the population are confined to diversified manufacturing and agriculture, and where there is a much higher density of population in both urban and rural districts. The mining industry being dependent upon the extent of certain definite ore deposits, with an element of uncertainty as to the duration of time that any individual mining property might conduct operations, requires a different set-up for power distribution under the "public ownership" policy which is prevalent in Southern Ontario, and in order to assure the industry of reasonable rates during the initial stages of development, the Commission entered into an agreement with the Province in June, 1933, whereby the Government provides the capital and the Commission constructs, operates and maintains all properties on behalf of the Province, also collects all revenues and takes care of all disbursements and expenses. Thus, the ownership of these properties is vested in the Province rather than the municipalities, although the Commission is responsible for the operation on behalf of the Government. Any deficits which might occur during the initial periods of operation of any particular development, or in any particular district, are charged to the Government, and any profits, before being disposed of must first be applied against eliminating whatever deficits might have accrued during the load building periods of the first years of operation.

All power systems in Northern Ontario under the jurisdiction of the Commission are operated in the manner outlined above, with the exception of the Thunder Bay System, and are known as "The Northern Ontario Properties". The Thunder Bay System was originally organized to serve the urban requirements at Port Arthur and Fort William, the large grain elevators in that locality, and for the pulp and paper industry. Later, as the mining industry developed east of Lake Nipigon in the Little Long Lac and Sturgeon River camps, the Nipigon developments from which power is secured for this area, having large blocks of unused power, were in a position to also supply the complete power requirements of the various mining properties which have recently come into existence.

Thunder Bay System

The developments supplying the Thunder Bay System are two in number and are located on the Nipigon River, the normal capacity being 123,500 h.p. The frequency is 60 cycles, and power can be delivered to mining properties at either 110 or 44 kv. This system is operated at cost, under the Power Commission Act, and is separate from the Northern Ontario Properties, but for the past few years it has been supplying power to the Little Long Lac and Sturgeon River mining camps. The firm power demands on these two developments at the present time approximate 65,000

Cameron Falls power development, Nipigon River.

h.p., which leaves 68,000 h.p. of existing generating plant capacity available for mining or any other type of load as required. Further development on the Nipigon River is also possible, and it is estimated that additional developments can be constructed at two sites which are capable of producing about 100,000 h.p. At the present time power is being supplied by the Commission from the Nipigon developments to the Northern Empire, Little Long Lac, Sand River and Leitch Gold Mines over a 44 kv. transmission line. A new 110 kv. transmission line is now under construction from Cameron Falls to Little Long Lac, approximately 93 miles in length, and plans are being prepared for the installation of a new transformer station at the terminus of same. This transmission line will have a capacity of approximately 20,000 h.p. The first transformer bank at Little Long Lac will probably have a capacity of 7,500 kv-a., and additional banks will be added as required. The first section of the new transmission line (Cameron Falls to Empire) will probably be completed and placed in operation at 44 kv. early in December of this year. The second section will probably be completed and placed in operation early in the spring of 1937. Both sections will be operated at 44 kv. until the new transformer station is placed in

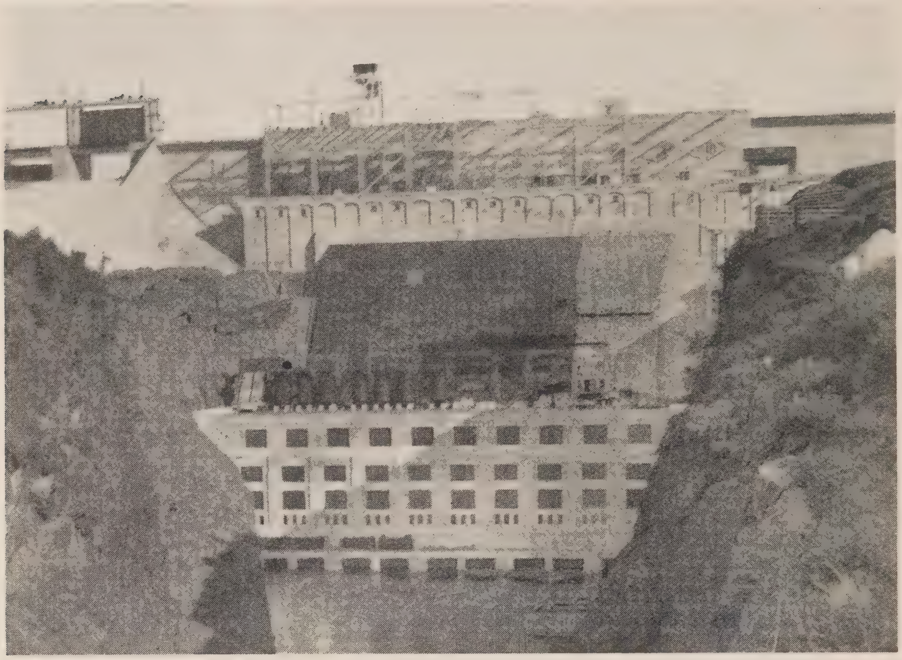
Alexander power development, Nipigon River.

operation, which will probably be in the fall of 1937. Upon completion of this transformer station the 110 kv. line will be used as a trunk circuit and the original 44 kv. line as a distribution feeder. The capacity of the Nipigon developments can be increased by what is known as the Ogoki diversion which provides for diverting the flow of the Ogoki River from the Hudson Bay's drainage area into Lake Nipigon and the Nipigon River drainage area, and increasing the normal flow of the latter by about 4,000 second feet. This additional flow will increase the possible output of the developed sites by about 50,000 h.p. and the possible output of the undeveloped sites by about 40,000 h.p. Therefore, it may be said that the possible power development on the Nipigon River approximates 300,000 h.p., of which 123,000 h.p. is already developed.

NORTHERN ONTARIO PROPERTIES
(Operated by the Hydro-Electric Power Commission on behalf of the Province of Ontario)

Abitibi District

This district is supplied with power from a 25-cycle development located at Abitibi Canyon on the Abitibi River, approximately 65 miles north of Cochrane. There are five units installed at this development and the normal capacity approximates 165,000 h.p. This capacity can be increased by improved regulation on the Abitibi River and by the construction of regulating dams, provision for which is being given consideration by the Commission's Engineers at the present time. The district served covers the area between James Bay and Copper Cliff adjacent to the Quebec interprovincial boundary, and includes the mining districts of Porcupine, Kirkland Lake, Matachewan, Ramore-Matheson and Sudbury Basin. Power is transmitted from the Abitibi Canyon development over four 110 kv. circuits on two steel tower transmission lines, two circuits being carried on each line, as far as the Hunta switching station, which is located approximately twelve miles west of Cochrane. A 110 kv. double circuit steel tower transmission line runs south from the Hunta switching station as far as Copper Cliff, feeding the mining

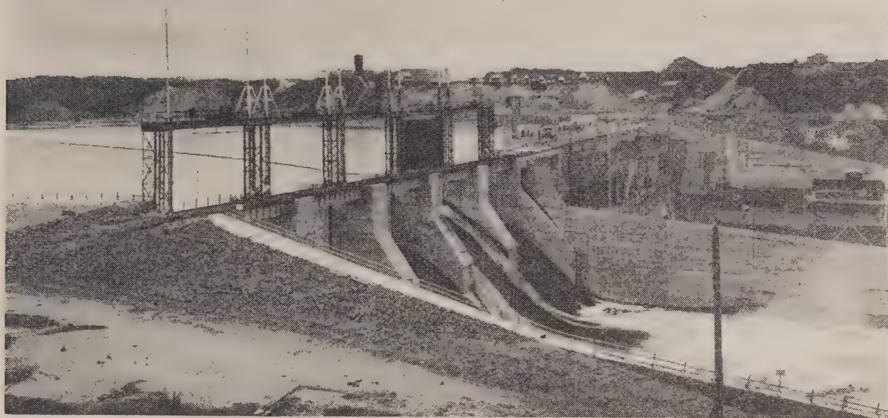


Abitibi Canyon generating station.

properties located in the Porcupine district, as well as the International Nickel and Falconbridge Nickel Companies in the Sudbury area. A 110 kv. double circuit steel tower transmission line also runs out of the Hunta switching station as far as Iroquois Falls and is continued on two single circuit wood pole lines as far as Kirkland Lake, from which point single circuit lines continue to Larder Lake and Matachewan. Power is transformed to 26.4 kv. at various main transformer stations located at Timmins, Matachewan, Ramore, Larder Lake and Falconbridge, and to 12 kv. at Kirkland Lake, and delivered to the various individual mining properties over 26.4 kv. and 12 kv. distributing transmission lines. At the present time approximately nine miles of wood pole 110 kv. transmission line is under construction from a point near Timmins to the Pamour Porcupine Mine, and at the terminus of same a new 4,500 kv-a. transformer station will be located. This station will probably be in operation in the fall of 1936. Plans are also being prepared for the installation of an additional 4,500 kv-a. bank of transformers at the Timmins transformer station.

Espanola District

This district embraces the territory adjacent to the Town of Espanola and 60-cycle power is purchased by the Commission from the Abitibi Power and Paper Company's development at Espanola. The only mine



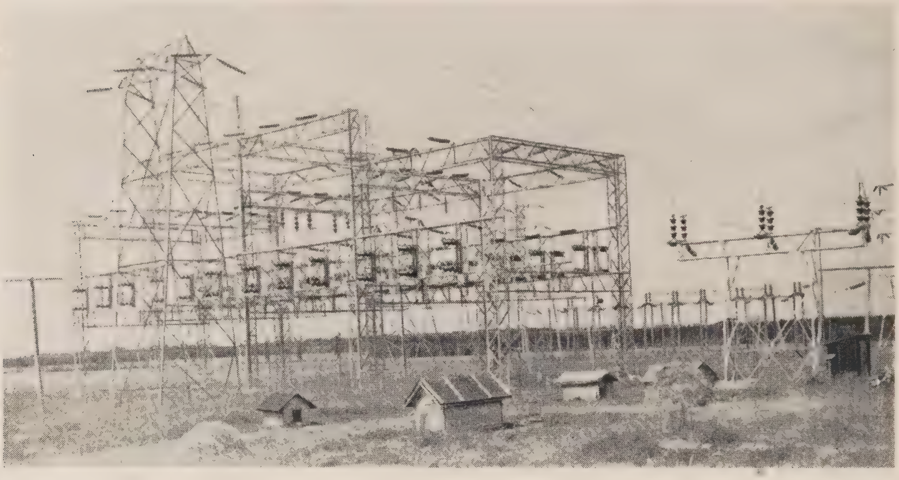
Main dam, sluiceway, high-tension switching structure and unloading crane over power house, Abitibi Canyon development.

served at the present time in this district is the McMillan Gold Mine, but power is available for any other properties which may at any future time require electrical energy for development or production purposes.

Nipissing District

This district is located adjacent to the eastern shores of Lake Nipissing in the vicinity of North Bay. Power is supplied from three 60-cycle developments on the South River, hav-

Transmission line, 110kv., Abitibi Canyon to Hunta.

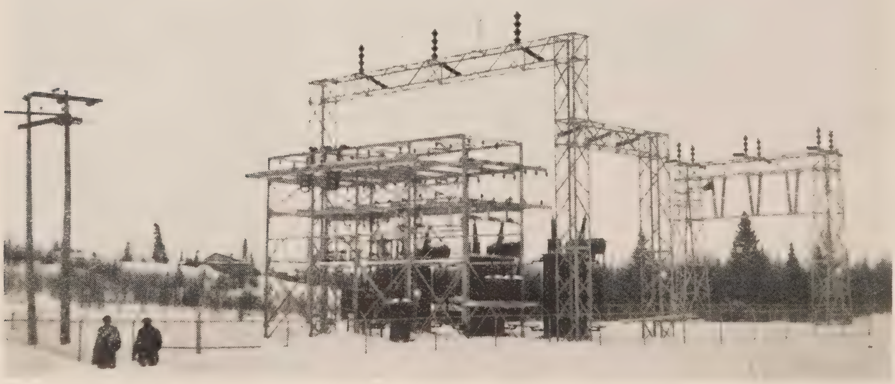


Hunta switching station.

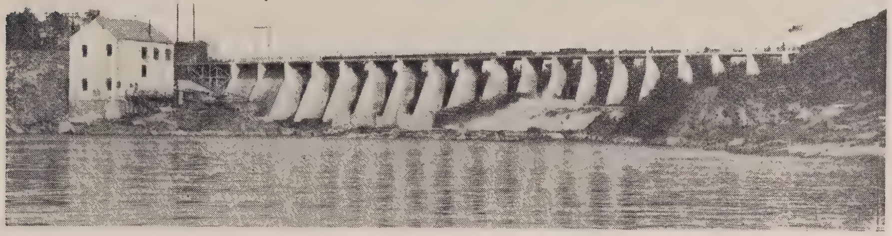
ing a normal capacity of approximately 2,100 h.p. At the present time no mining properties are served by these developments, but arrangements can easily be made to provide additional sources of power should it ever be necessary in future to supply any mining properties from the distributing transmission lines in this district. The trunk transmission lines are operated at 22 kv. The principal power market is the city of North Bay and vicinity.

Patricia District

This district comprises the territory which can be served from the present Ear Falls development of the Commission located at the foot of Lac Seul on the English River. At the present time one generating



Larder Lake transformer station.

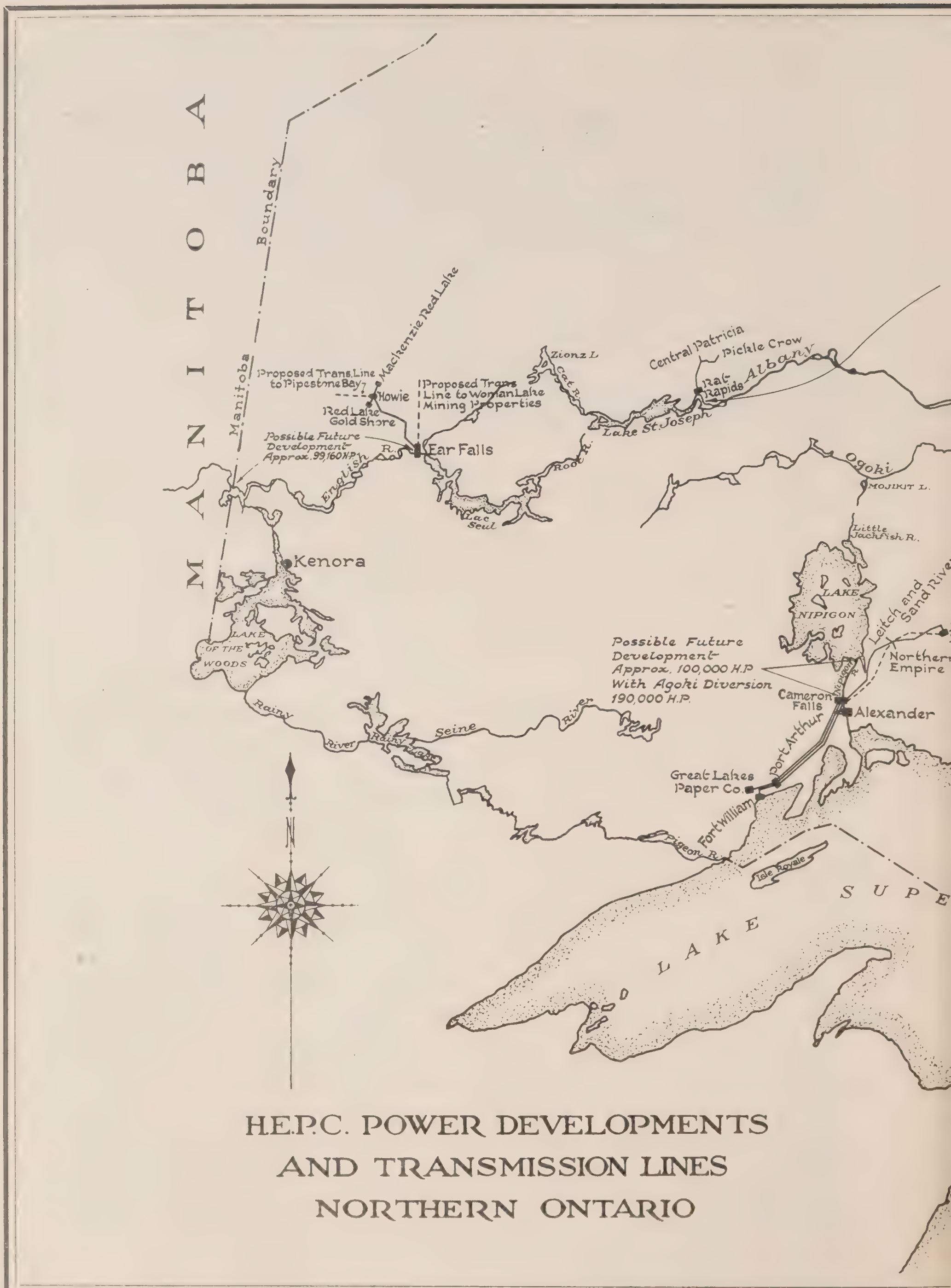


Ear Falls power development, Lac Seul.

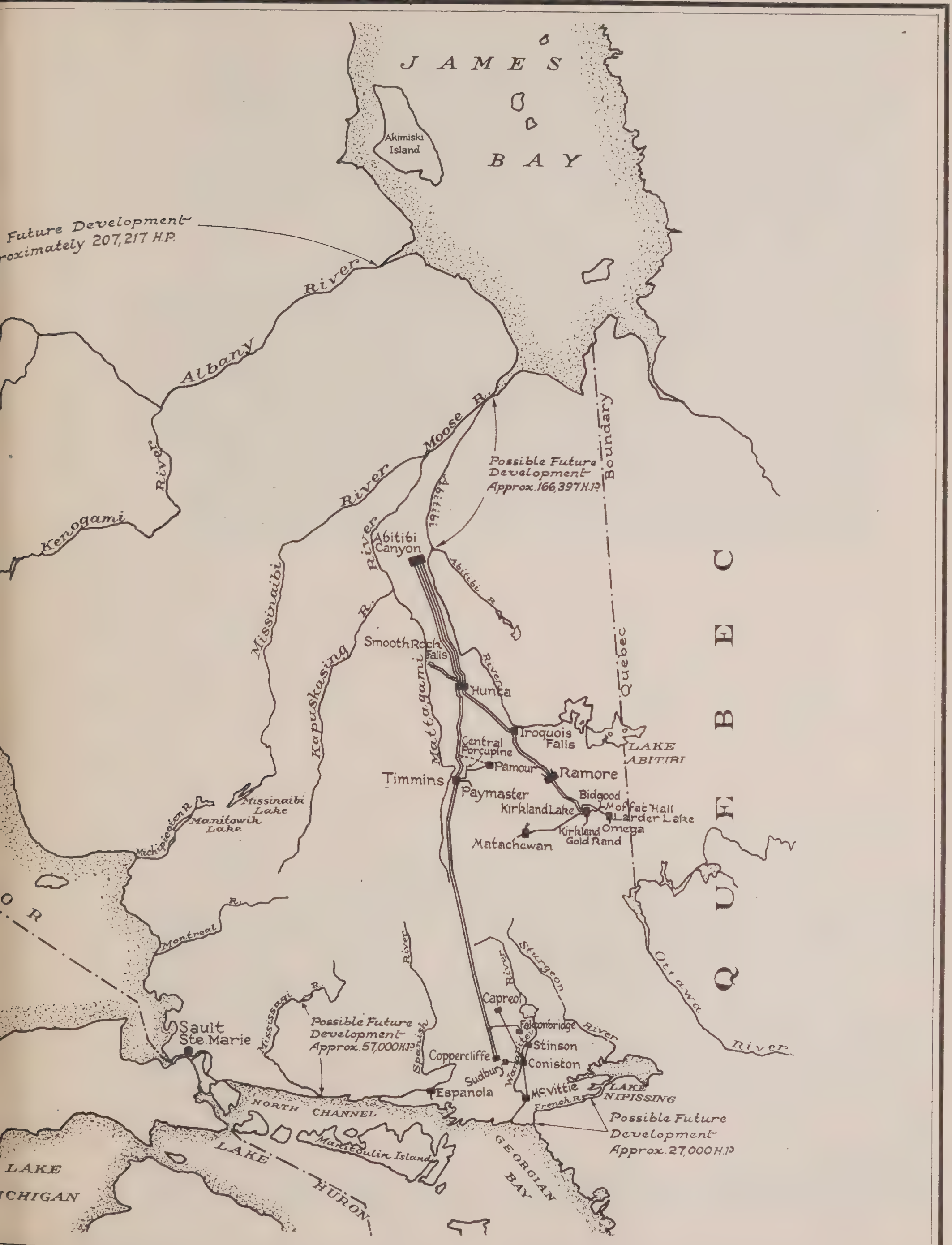
unit of 5,000 h.p. capacity is installed and operating at Ear Falls and this development is being enlarged at the present time by the installation of a second unit which will be completed and placed in operation in the early summer of 1937, at which time Ear Falls development will have a capacity of approximately 10,000 h.p. As demand is created by new mining properties coming into production, additional units will be installed at this site, the total possible output being approximately 25,000 h.p. From present indications it is quite probable that provision will have to be made for a third unit before the second unit is completed and placed in operation. At the present time power is supplied to the Howey, McKenzie Red Lake and Red Lake Gold Shore Mining properties, all located in the Red Lake mining district. Power is delivered over a single circuit 44 kv. transmission line. Contracts have also been executed with the Gold Eagle, Skookum and Madsen Red Lake properties, and as soon as these companies have completed their transmission lines and transformer stations, power will be supplied from the existing unit. Consideration is being given at the present time to an extensive programme of transmission line construction out of the Ear Falls development for supplying the growing load in the Red Lake mining district. Negotiations have been carried on with other mining properties in both the Red Lake and Woman Lake districts, and as soon as the various companies now under development or operating by diesel engine power are in a position to execute contracts and construct transmission lines, arrangements will be made by the Commission to take care of their requirements.

St. Joseph District

The St. Joseph district comprises the territory adjacent to Lake St. Joseph on the Albany River. Power is supplied from a 60-cycle development located at Rat Rapids at the foot of Lake St. Joseph. The normal capacity of this development at the present time is approximately 1,000 h.p., although at various times the output has been as high as 1,300 h.p. A second unit is being installed at this development at the present time and will be in operation about Octo-

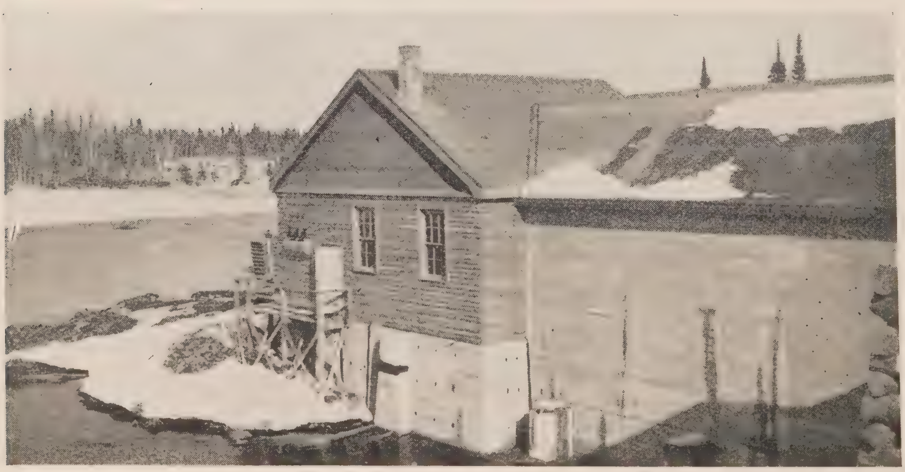


HEPC. POWER DEVELOPMENTS AND TRANSMISSION LINES NORTHERN ONTARIO

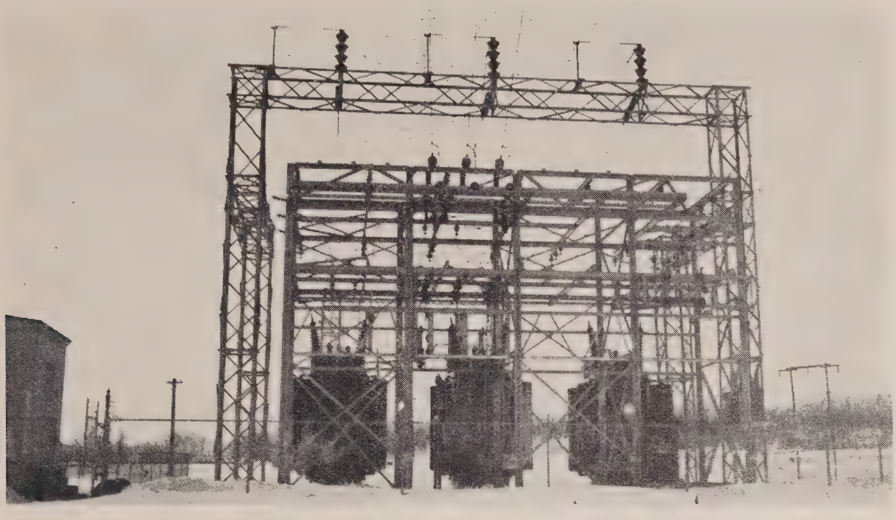

JAMES BAY
Akimiski Island
Future Development
roximately 207,217 H.P.
Albany River
Kenogami
River
Moose R.
River
Possible Future Development Approx. 166,397 H.P.
Boundary
Abitibi
Abitibi Canyon
Abitibi R.
River
Missinaibi
Kapuskasing R.
Smooth Rock Falls
River
Hunta
Mattagami
Quebec
QUEBEC
Iroquois Falls
LAKE ABITIBI
Central Porcupine
Pamour
Ramore
Timmins
Paymaster
Bidgood
Kirkland Lake
Moffat Hall
Larder Lake
Omega
Kirkland Gold Rand
Matachewan
Missinaibi Lake
Michipicoten R.
Manitowik Lake
Michipicoten
R.
Montreal
River
River
Sturgeon
Ottawa
River
Capreol
Falconbridge
Stinson
River
Coniston
Possible Future Development Approx. 57,000 H.P.
Mississagi R.
Spanish
Sault Ste. Marie
Coppercliffe
Sudbury
Wanapitei
Espanola
McVittie
LAKE NIPISSING
French R.
Possible Future Development Approx. 27,000 H.P.
NORTH CHANNEL
Manitoulin Island
LAKE HURON
GEORGIAN BAY
LAKE MICHIGAN

Rat Rapids development, Lake St. Joseph.

ber 1st, 1936, at which time the capacity of the development will be in the neighborhood of 3,000 h.p. It is possible to develop 5,000 h.p. at this site, and when additional power is required, other sites on the Albany River can be developed. At the present time the Pickle Crow



Rat Rapids generating station.



Falconbridge transformer station.

and Central Patricia Gold Mines are receiving service from this development, and a contract has been recently executed for a supply of temporary power to The Albany River Mines. Plans are being prepared in connection with constructing a duplicate transmission line in this district to provide for load increase from existing and future customers.

Sudbury District

This district comprises the area adjacent to the city of Sudbury and is served by three 60-cycle developments on the Wanapitei River, having a normal capacity of approximately 16,300 h.p. The main transmission lines are operated at 22 kv. The mining properties supplied with power from these developments are owned and operated by the International Nickel Company and Falconbridge Nickel Companies.

* * * *

The expansion in the mining industry in Northern Ontario from the time the Commission first began to supply power to this type of load in 1929 is reflected in the remarkable load growth which has taken place since that date. The following table gives the power sold and the number of mines under contract for power supplied by the Commission, together with the yearly increase from 1930 to June, 1936, inclusive.

In addition to mining properties now being served or under contract, agreements for power supply are under negotiation between the Commission and a large number of other mining companies, and it is anticipated that probably eleven additional contracts will be secured before the end of 1936, which will make the increase twenty-two new contracts for 1936 over 1935. As a number of properties already being served are making provision for increasing pro-

POWER SOLD AND NUMBER OF MINES UNDER CONTRACT

Year	Power Sold as at Oct. 31st	Increase over the previous year	Number of Mines Supplied or under Contract	Increase over the previous year
1930	10,503 h.p.	———	4	—
1931	25,848 "	15,345 h.p.	5	1
1932	25,985 "	137 "	5	—
1933	26,804 "	819 "	4	1 (Decrease)
1934	44,086 "	17,282 "	9	5
1935	55,472 "	11,386 "	19	10
1936	65,928 "	10,456 "	30	11

duction, and as provision must be made for taking care of these conditions, as well as for power required by new properties now negotiating power contracts, the Commission is conducting an extensive construction program, both with respect to increased development, as well as providing additional transmission and transformation capacity. The enlargement of the Ear Falls and Rat Rapids developments, the construction of new 110 kv. trunk transmission lines and the construction of new transformer stations indicating the activities of the Commission in providing for the rapidly expanding power market in mining districts have already been referred to under the descriptions of the activities in the various individual districts comprising Northern Ontario Properties.

The following tabulation gives the mining properties served by the Hydro-Electric Power Commission, and the load taken by each mine for the month of June, 1936:

	H.P.
Abitibi District	
Bidgood Kirkland	764.0
Central Porcupine	260.0
Falconbridge Nickel	1,299.2
Glenora	176.8
Hollinger Consolidated (Hislop)	609 9
Hollinger Consolidated (Young-Davidson)	1,769.4
Huronian Co. (Int. Nickel Co.)	14,658.0
Huronian Co. (Refinery)	4,933.0
Matachewan Consolidated	571.0
Moffatt-Hall	150.0
Northern Canada Power Corporation	20,093 8
Omega	1,081.2
Pamour	1,764.0
Paymaster	1,673.0
Vimy	150.0
Espanola District	
McMillan	197.8
Patricia District	
Gold Eagle (Not yet taking power)	....
Howey	2,781.5
Madsen Red Lake (Not yet taking power)	....
McKenzie Red Lake	607.2
Red Lake Gold Shore	220.3
Skookum (Not yet taking power)	....

	H.P.
St. Joseph District	
Central Patricia	665.0
Pickle Crow	630.0
Sudbury District	
Falconbridge Nickel	3,868.6
Huronian Co. (Mond Nickel)	4,161.0
Thunder Bay System	
Leitch	150.0
Little Long Lac	1,655.6
Northern Empire	883.3
Sand River	150.0
Total	65,928.0

Taking the present power sold to mining properties as 65,928 h.p., and forecasting the future demands, careful surveys indicate that the Commission will probably be supplying in the neighborhood of 84,000 h.p. to the various mining properties in Northern Ontario by the end of the calendar year of 1936, and 110,000 h.p. by the end of 1937. By this remarkable increase in the demand for power, it is possible to gauge with a fair degree of accuracy the tremendous expansion which is taking place in the mining industry in Northern Ontario, and the Hydro-Electric Power Commission is constantly on the alert to provide the necessary developments, transmission lines and transformation capacity with which to supply this extraordinary load growth.

Northern Ontario, considering that portion north of the French River and Lake Nipissing, and west of the Quebec boundary, is a vast territory capable of enormous mineral development, and producing mines at the present time only represent a small fraction of the probable number that will eventually be required to fully and adequately develop the mineral resources of the area. The expansion which has taken place in the last two years is only a beginning of what may be expected in the next ten years; consequently, it is both essential and necessary that an adequate program of hydro-electric power development, together with the requisite transmission lines, be properly arranged to keep pace with the power demand which will be created, irrespective of whatever such demand may be. The total amount of undeveloped water power in this district, which is not yet utilized, has already been referred to as approximating 1,800,000 h.p., therefore, it is reasonable to assume that there will be no impediment to the progress of mining operations in Northern Ontario as far as power supply is concerned, providing that the construction program for new power developments, transmission lines and transformer stations is properly planned and adhered to, so as always to be in advance of requirements.

That the Hydro-Electric Power Commission is fully conversant with these conditions, and has adopted an aggressive policy in dealing with the various problems involved, and arriving at a satisfactory solution of same, is verified by reviewing its activities during the last five or six years. Starting from zero in 1929 the Commission is now serving mining properties in Northern Ontario from eight Hydro-Electric developments, having a combined normal capacity of approximately 317,800 h.p. taking into consideration the in-

creased capacity now being installed at Ear Falls and Rat Rapids. Three of these developments are supplying firm power for mining purposes almost exclusively. All of the power developments of the Commission in Northern Ontario are located at strategic points with respect to the present areas in which mining operations are most active. Transmission lines have been constructed from these developments to the various mining camps now operating and at the present time 668 miles of 110 kv., 142 miles of 44 kv., and 76 miles of 33 kv., 26.4 kv., 22 kv. and 12 kv. transmission lines are being utilized for power distribution purposes, taking into consideration lines under construction at the present time.

The mining load on the Commission's Northern Ontario properties for the month of June, 1936, as previously referred to, has reached 65,928 h.p., and 28 mining properties are being supplied with power. This represents a growth from zero in the last six years. Future sources of power development are also of vital importance when consideration is given to a continued increase in the expansion of the mining industry, in both existing camps, and in the probable discoveries of new areas yet unprospected in the Northern Ontario field. For the Porcupine, Kirkland Lake, Larder Lake, Matachewan, Ramore and Sudbury areas served by the Abitibi Canyon Development, future demands for power can be supplied from further development on the Abitibi River north of the present Canyon site, and further undeveloped sites on the French and Mississauga Rivers, and if necessary further undeveloped sites on the upper Ottawa River. According to the Surveyor General's 1931 Report, there are seven sites on the Abitibi River between the Canyon development and its junction point with the Moose River, a distance of approximately ninety miles, the estimated capacity of which at 80 per cent. efficiency at ordinary six months' flow is given as 166,397 h.p. On the French River approximately 50 miles southeast of Sudbury some 27,000 h.p. can be developed, and on the Mississagi River, approximately 75 miles west of Sudbury, the capacity of undeveloped sites is in the neighborhood of 57,000 h.p. If necessity requires the utilization of the Ottawa River for power development to supply the Northern Ontario mining industry, three sites are available at Forneau, Cave or Les Erables and Deux Rivieres, which according to the Surveyor General's 1931 Report have an estimated capacity at 80 per cent. efficiency at ordinary six months' flow of over 160,000 h.p.

The geographical location of the Albany River is also ideal from the power standpoint, as it passes through the centre of the new Ontario district. The Surveyor General's 1931 Report gives 28 power sites on this stream between Lake St. Joseph and James Bay, having an estimated capacity at 80 per cent. efficiency at ordinary six months' flow of 207,217 h.p., and the power requirements of any mining operations which may be conducted in the Northern section of the Northern

Ontario district can, therefore, be adequately supplied from that source.

The available power output from future development on the Nipigon River has already been referred to as 100,000 h.p., and with the increased flow created by the Ogoki diversion as approximating 190,000 h.p. Reference has been made to the possible increase in power output at the existing Ear Falls development from 10,000 h.p. to 25,000 h.p. Future development is also possible on the English River between Ear Falls and the Manitoba boundary, the Surveyor General's 1931 Report giving nine sites in that location, with an estimated capacity at 80 per cent. efficiency at ordinary six months' flow of 99,160 h.p. The availability of future power development throughout the entire mining area of Northern Ontario, and the possibility of generating large blocks of hydro-electric power for mining operations has been stressed with the specific purpose of submitting conclusive evidence that no power shortage need be feared by any legitimate mining venture.

With the mining industry in Northern Ontario definitely established and rapidly expanding, and with indications of numerous possibilities of future discoveries in existing and unprospected areas, and with definite assurance of adequate power facilities to carry on development and production, the remaining items of importance which must be considered are the rates at which power can be sold and the terms of contract under which delivery is made. In this respect there are two outstanding essentials which must be followed, viz., the safeguarding of the investment of public funds, and the adoption of a rate schedule enabling the purchase of power to be made at reasonable cost to operating companies. The Commission's standard mining contract embraces these two objectives. The necessity of protecting the investment of public funds is obvious when it is considered that according to the Commission's 28th Annual Report for the fiscal year ending October 31, 1935, the total investment in the Northern Ontario Properties is given as $30,739,704.70, most of which is utilized for serving mining properties. This investment is rapidly being increased by expenditures for extensions to power developments, new transmission lines and new transformer stations, detailed mention of which has already been made. The contract requires the customer to provide a bond made up of two parts, one to cover the immediate investment necessary to be made in transmission line costs to serve the specific mining property to be supplied with power and the other to cover three months' power bills. When a mining district is firmly established and under production no part of the power development, trunk transmission line or main transformer station costs are required to be covered by a customer's bond. In such instances the bond covers the branch transmission line only. In new mining districts, largely in the development stage, customers have been required to bear the entire transmission line

cost, irrespective of the distance of the mining property from the development, and later when mills have been placed in production these transmission lines have been purchased by the Commission from the customers and utilized as trunk lines to serve all operating properties in that particular district. The portion of the bond covering the transmission line investment of the Commission is called the base minimum, and the total amount of the base minimum must be paid in revenue. This portion of the bond is refunded to the customer on the basis of 10 per cent. per annum, or 25 per cent. of the total annual revenue, whichever is the greater amount. The contract also covers the delivery of a fixed amount of power which may be increased to an amount agreed upon for meeting the customer's future requirements. The point of delivery is the customer's transformer station, with the Commission assuming the transmission losses. Power is delivered at transmission voltage, generally at 26.4 or 44 kv. A minimum amount of power must be paid for to assure the Commission of a fixed revenue, commensurate with the specific investment required for serving the property under contract. This minimum advances with the peak load created by the customer in any particular month and is set as 75 per cent. of the maximum peak established. At the end of each contract year this minimum may revert to 50 per cent. of the highest peak established in any month during the previous year. Any peak which may be inadvertently established is not taken into consideration in determining minima. The term of the contract is for ten years, or the mining life of the property. If at any time during the continuance of the contract a fault in the customer's ore bodies makes necessary extensive exploration work to locate future working ore bodies, and thereby makes necessary a substantial or complete shut-down of the customer's mill, the customer is entitled to the privilege of declaring what is known as a fault period, during which the minimum amount of power to be paid for designated as the "fault minimum" is determined on the basis of 25 per cent. of the highest peak created during the twelve months' period immediately prior to the declaration of the fault period, or 75 per cent. of the greatest amount of power taken during the fault period. If within three years of the commencement date of the contract the customer abandons all mining operations, the minimum bill called for in the contract is paid for two months, and the contract may then be cancelled without further penalty. Abandonment after three years of operations may be made without any penalty whatsoever. The operations of the customer during a fault period are limited, firstly to exploration work for preserving mining properties—from physical loss or damage, and secondly to only that amount of development work and milling which is necessary for handling ore obtained in exploring for new ore bodies and in cleaning up old ore bodies. Abandonment of mining operations con-

sists of ceasing all work in connection with production and treatment of ore, exploration, development and other mining work for preserving the mining property from physical loss or damage.

Power is paid for on the basis of the highest ten minute average or integrated peak created during each month at 85 per cent. load factor and 85 per cent. power factor. Penalties are required for loads established below 85 per cent. power factor and above 85 per cent. load factor. The prevailing rates in the Abitibi District for 26.4 kv. power are $32.50 per h.p. per annum for demands up to 5,000 h.p., $22.50 for demands between 5,000 and 10,000 h.p., $17.50 for demands between 10,000 and 20,000 h.p., and $22.50 per h.p. per annum for all power taken over 20,000 h.p. In the Little Long Lac and Sturgeon River areas the prevailing rates are $35.00 per h.p. per annum. Up to the present time no demands above 5,000 h.p. have been created by any of the mining companies in that district, and consequently a sliding scale of rates has not yet been adopted for demands up to 20,000 h.p. In the Red Lake district the prevailing rate is also $35.00 per h.p. per annum. In districts where special developments are required to serve specific mining properties such as the Pickle Crow and Central Patricia mines at Rat Rapids, special rates are adopted.

The entire rate schedule of the Commission for all districts has been built up on the basis of providing an amortization fund to retire all capital investment in connection with mining properties in a reasonable time, such as from ten to twelve years, considering the probable mining life of the various properties to which power is being supplied. The rate is also based on collecting sufficient revenue to meet all operating and administration costs, as well as fixed charges including the amortization fund mentioned above. In cases where special rates have been adopted for serving isolated properties from individual developments, provision is made for a reduction of approximately 50 per cent. if the mining properties carry on operations and create a demand for power after the amortization fund has been completely set up.

In conclusion it might be said that in supplying power for mining purposes in Northern Ontario, the endeavour of the Commission is to give the same standard of service as it has established throughout the southern sections of the province as far as it is in a position to do so, and to maintain the same engineering standards in design and construction of equipment which has always characterized Hydro service from its inception.

Lighting Campaign Progress

CONSIDERABLE progress has been made in the organizing of a Province-wide campaign to promote Better Light for Better Sight, the latest development being the organizing of individual or groups of municipalities into campaign units.

As the promotion of Better Seeing is a new departure in most Hydro municipalities, it has been necessary to plan the Lighting Campaign along the most economical lines, and with this object in view the municipalities who feel that they could not afford the expense of full time employees engaged in lighting promotional work have been combined into groups where possible, and in each group one or more so-called Home Lighting Advisers is employed to organize a lighting campaign in each municipality in the group and to carry on a lighting activity according to the plans laid down by the Commission.

Up to the present time the following municipalities and groups of municipalities have joined in this new effort:

Group 1—Carleton Place, Smith's Falls, Brockville.

Group 2—Napanee, Picton.

Group 3—Cobourg, Bowmanville, Whitby.

Group 4—Toronto.

Group 5—Hamilton.

Group 6—Welland, Port Colborne, Thorold.

Group 7—Simcoe, Waterford, Port Dover, Paris.

Group 8—Ingersoll, Woodstock.

Group 9—London.

Group 10—St. Thomas, Aylmer, Tillsonburg.

Group 11—Strathroy, Watford, Ridgetown.

Group 12—Chatham.

Group 13—Sarnia.

Group 14—Windsor.

Group 15—Barrie, Penetanguishene, Huntsville, Gravenhurst.

Group 16—Blenheim.

In Belleville, Oshawa, Peterboro, Galt, Kitchener and Stratford the activity is being carried on as well along somewhat similar lines.

In planning the campaign in these municipalities it was found necessary to educate a number of so-called Home Lighting Advisers to carry on the work in these municipalities, and in order to give them the best education possible a class was organized and sent to Nela Park at Cleveland, where the most modern equipment for demonstrating and educational purposes is to be seen. This is really the focal point of Better Light—Better Sight information.

Eighteen students, representing 35 municipalities, attended the 3-day school and received sufficient training to enable them to go back to their respective municipalities and organize and carry on a well planned lighting campaign.

Based upon the experience of several Hydro municipalities, particularly Windsor, Simcoe, North Bay, London and a few others, we are confident that a lighting campaign prop-

Group of Home Lighting Advisers and Supervisors attending Lighting School at Nela Park, Cleveland, Ohio, October 12, 13 and 14, 1936.

Back row—(left to right)—Evelyn Ditchburn, Cobourg, Bowmanville and Whitby; Alice Moulton, Barrie, Gravenhurst, Penetanguishene and Huntsville; Myra Collins, Welland, Port Colborne and Thorold; Olive Thompson, Simcoe, Paris, Port Dover and Waterford; G. J. Mickler, H.E.P.C. of Ontario; Marion Kidner, St. Thomas, Aylmer and Tillsonburg; Elspeth Smith, Napanee and Picton and Isobel Firth, North Bay.

Second row—Frances Thompson, Canadian General Electric; Gertrude Robertson, Blenheim; Louise B. Conger, Toronto; Anne Hickson and Adele Ditchburn, H.E.P.C. of Ont.; Vivian Ross, Woodstock and Ingersoll; and Franc Robinson, Windsor.

Front row—J. S. Boulden, Sarnia; G. Fraser, London; L. Rutty, Hamilton, and E. Tugwell, Chatham.

erly planned and well conducted can be made to succeed. What is required, however, is the full co-operation of all branches of the electrical industry, both local and provincial, and it is confidently expected that in the municipalities enumerated above a very creditable showing will be made during this present lighting season.

The Commission is prepared to assist all Hydro municipalities in promoting lighting campaigns through their staff of Supervisors who have received special training to fit them for this work, and if any other municipalities wish to embark upon this activity every assistance will be given them and arrangements will be made to train the persons who will have to do the actual campaigning in each municipality.

Tented area.

Hydro Demonstration at Provincial Plowing Match at Cornwall

THE Commission again made a demonstration of electrical equipment suitable for use on farms and in rural homes, at the Provincial Plowing Match, which this year was held in Glengarry County, north of the city of Cornwall.

The local committees under the chairmanship of J. W. McCrae, were successful in developing an unexpected enthusiasm, which resulted in a very large attendance for a location so far east.

The association was fortunate in the selection of time for the contest, as the weather was wet before and after this period.

The tented city covered an area of sixteen acres, being arranged in an oblong form, with streets 50 feet wide on which all concessions faced. The frontage of manufacturers' concessions was about 2,000 feet, the greatest of any match to date. In addition, there were about 500 feet of cafeteria area front.

The local electrical distribution system for service to applicants, required 40 kilowatts of transformer capacity and a secondary bus system of about 1,200 feet. Twelve street lights illuminated the area at night.

The water system consisted of three 500-gallon tank wagons for storage to which an automatic electric pump was connected, having a capacity of 600 gallons per hour, to supply a main 1,200 feet long, with eight taps conveniently located on it, as well as the free hot-water tank in the Hydro tent and another in the Eaton rest tent. The new Cornwall street-sprinkler truck tank hauled 30,000 gallons of water to supply the storage system.

The equipment on display in the

Crowd in one of the streets of the tented city.

Hydro tent was arranged in two sections. In one part electrically-driven apparatus was displayed which might profitably be used in the barn, dairy or pumphouse, including automatic water systems, utility motor choppers, automatic milk coolers, electric motors and motor parts. In the other section were shown a complete line of electric ranges and appliances for the house were on display, which in-

Tractor plowing.

cluded rangettes, washing machines, ironing mangles, refrigerators, radios and table appliances.

Attendants supplied particulars as to applications and costs of the equipment. Hydro engineers gave information regarding Hydro-Electric service to farms, rural residences and urban municipalities, as well as specific advice to those enquiring. They also engineered the various arrangements of the tented city.

Electrical service was supplied to the demonstration area by the Stormont Electric Company.

Manufacturers' representatives in attendance reported very satisfactory prospects for business, and were pleased with the results of their demonstrations.

The plowing match and its demonstration of farm machinery is certainly appreciated as a means of contact between manufacturers and farmers.

Frank Gover, Orillia, Retires

THE members of the Orillia Water, Light and Power Commission and the employees of the public utilities joined on the evening of Wednesday, September 30th, in an impressive tribute to Frank Gover, the retiring Secretary-Treasurer. The affair was initiated and organized by the staff, and their wives and daughters served a most appetizing supper. The whole affair afforded a striking demonstration of the good feeling that exists among the Commission's staff, and of their high regard for Mr. Gover.

J. C. Miller, who acted as toastmaster, made a very happy inaugural speech, in which he eulogized Mr. Gover for his faithful service to the Commission and for his public spirited activities in connection with the church, in musical circles, socially and as first chairman of the anti-mosquito campaign. Mr. Miller called attention to the fact that during Mr. Gover's tenancy of office the capacity of the plants had increased from 1,600 h.p. to 12,000 h.p., and the number of employees from 15 to about 50. He likewise paid tribute to part played by Mrs. Gover.

Mayor Johnston, Alex. Ritchie, chairman of the Commission, and Clarence Long added their testimony to Mr. Gover's satisfactory services and many fine characteristics and joined in the hope they would take up their residence in town.

A. H. Huffman, electrical foreman, then read the following address from the employees, who joined in making it clear that the Secretary-Treasurer had won their esteem and respect and was very popular with them. The address was accompanied by a handsome smoking jacket for Mr. Gover and a nicely equipped travelling case for Mrs. Gover.

"Dear Mr. Gover:—We feel that

we cannot see you leave us without expressing our regret at the severing of the relations which have existed between you and the employees of the Orillia Water, Light and Power Commission.

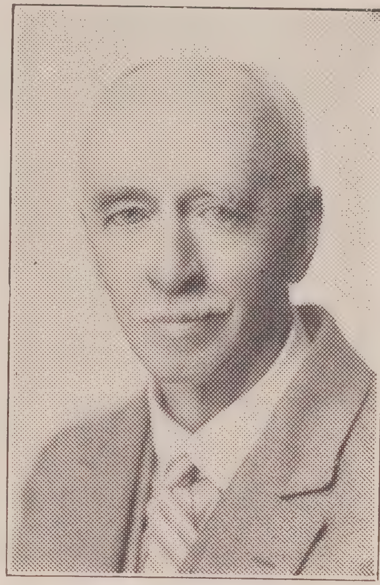
"During the time we have cooperated in the work of building up and operating Orillia's utilities we have learned to appreciate your efficiency as a Secretary-Treasurer, and your consideration for your fellow-men.

"We assure you that you carry with you both our friendship and esteem and our best wishes for the future wherever you may go. We shall always be glad to hear of any good fortune that may come to you.

"We ask you and Mrs. Gover to accept these humble gifts as a slight token of the sincerity of these sentiments, and trust as you use them that they may recall pleasant recollections of your association with us."

The address from the Commission, which will be engrossed as a memento of the occasion, was read by C. H. Hale, one of the original Commissioners responsible for Mr. Gover's engagement:—

"Dear Mr. Gover:—When the Orillia Water, Light and Power Commission was organized nearly a quarter of a century ago, for the purpose of taking over the management of the Town's electrical and waterworks utilities, by a combination of discernment of character and good fortune they chose you to fill the important post of Secretary-Treasurer of the new organization.



Frank Gover

During all the intervening years, the Town and Commission have had reason to be gratified at your appointment. Never once have the Commission had occasion to feel dubious on that point to the slightest degree.

"Not only have you given faithful and efficient service but you have identified yourself with the business and aspirations of the Commission, and have given such helpful counsel, based on good judgment gained by experience and familiarity with all phases of the work, that it is hard to envisage the future without you at the post where you have been found with such regularity and punctuality.

"The Commission parts with you in an official capacity with genuine regret. Yet we realize that you have well earned surcease from exacting

toil, and we trust that the period of leisure may be long and happy, a wish which we extend to Mrs. Gover also.

"In all this, we are sure we are expressing the sentiments of our numerous customers and of the townspeople generally.

"In closing may we express the hope that you have grown into too good Orillians to make your home anywhere but in this town."

Mr. and Mrs. Gover thanked the donors for their kindness. Mr. Gover spoke feelingly of the pleasure it gave him to receive such evidence of the goodwill of his fellow employees.

Mr. and Mrs. Gover plan to leave Orillia early in November for a visit to the old country.—*Packet-Times.*

* * * *

Although Orillia is not a Hydro municipality, the Orillia Water, Light and Power Commission has always been closely associated with the Hydro-Electric Power Commission of Ontario. The Orillia system has been tied in with the Hydro Commission's Georgian Bay System for a number of years for the purpose of interchange of power and serving Hydro rural loads over Orillia lines. Also the Orillia Commission has always been actively interested in Hydro affairs generally taking part in the work of the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities. We are pleased, therefore, to add our tribute to those extended to Mr. Gover, with the wish that he may be long spared to enjoy his retirement.

Orillia Water, Light and Power Commission Swift Rapids Generating Station, Severn River.

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London Lighting Show

THE London Public Utilities were the sponsors of one of the best lighting shows ever put on in Canada. Over 15,000 square feet of space in an unoccupied building was devoted to exhibits of all kinds of good and inferior lighting equipment and methods, and a most complete story of how lighting should be done was given by demonstrations, by word of mouth and by comparisons with out-of-date methods.

The show consisted of a series of

The Talking Living Room in the foyer of the Exhibition.

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November, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

niches and alcoves arranged along the walls of the building in which the outstanding principles of proper illumination were brought out by unique demonstrations and these principles were applied to all kinds of lighting requirements, in the home, office, factory, store and school, and those who visited the show could not but be convinced that there is a right and a wrong way to light every place that requires illumination and that the right way is the best way.

It is impossible to describe all of the exhibits, but the pictures which are shown herewith tell the story fairly well, although to be appreciated the show should have been visited personally, as comparisons between the good and the bad could not be shown by photographs.

One of the outstanding features of

A general view of the industrial and commercial section. Various types of fixtures are supplying the general illumination.

Another corner of the domestic section showing the wrong method of lighting a bedroom and suggested renovations. A corner of the kitchen and bathroom section is seen at the left.

this show was the model rooms in miniature in which proper and improper lighting were demonstrated. There were two model living-rooms, two model kitchens, two model offices and two model school-rooms treated in this fashion. A complete line of floor and table lamps, wall and ceiling fixtures for all purposes was on display, and then at the entrance to the main exhibit a talking living-room demonstrated how the lighting in an ordinary living-room can be improved by making use of the new type of lighting equipment. In this talking living-room the effect of each lighting unit good and bad was demonstrated and explained through the microphone by means of a concealed automatic recording apparatus and it gave a complete story of how to revamp the old lighting methods.

The show lasted for two weeks and was very well attended and from all sides are coming words of praise for the ingenuity and enterprise of those responsible for the show. Parts of the exhibit are being transported to other municipalities for similar demonstrations for educational purposes.

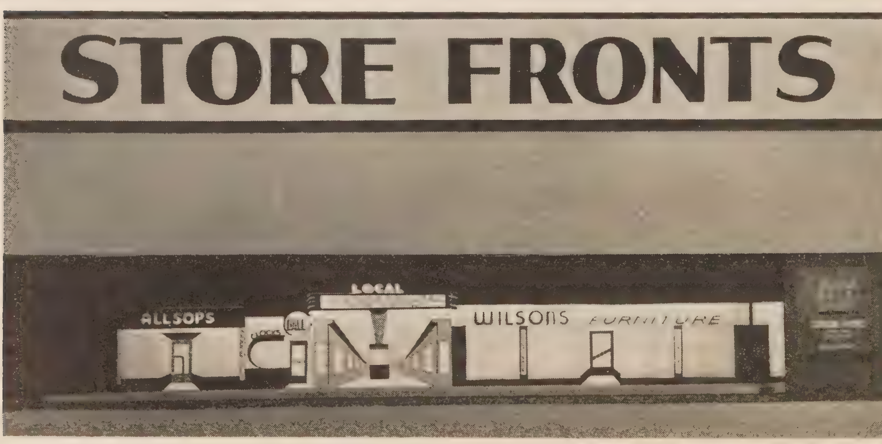
A general view of the domestic section and Lamp Show. Arrangements were such that visitors had first to pass the Science of Seeing story in the niches on the outside before they could enter the Lamp Show.

A corner of the domestic section showing a view of the niches used to tell the story of light and its applications. Some twenty niches in all were required. In the alcove on the right is a collection of old lamps with a sight-meter on a chain so that visitors could see for themselves just what light the old lamps were giving.

Two other niches used to demonstrate proper lighting in the Living Room. The room on the right has four good places to read, while that on the left has only one doubtful one. These installations are 14 in. by 16 in. by 24 in. and lighting is done with flashlight bulbs.

The store interior lighting display showing various methods of shelf lighting. The counters are lit to an intensity of 50 foot-candles with Holophane contro lens and Curtis counter lights recessed in the ceiling. The illumination in the show window on the left builds up automatically from 50 w. per ft. with bare lamps to 200 w. per ft. with reflectors.

Another view of the industrial and commercial section. The exhibits of industrial reflectors are at the extreme end on the left. The church lighting exhibit is seen on the left and has a similar lantern to that showing but with a Holophane reflector inside. The cleaning and relamping alcoves included dirty and clean reflectors and new and old lamps with a lightmeter below. All these exhibits flash automatically from one to the other every four seconds.



Modern main street. Small model store fronts showing applications of luminous fronts.

The Old Homestead Goes Electric

By Ethel Chapman

The following story, taken from *The Farmer Magazine*, tells of the use of Hydro in an Ontario farm home. It is of particular interest since it gives the woman's reactions regarding the service, and shows how electricity can be made to remove much of the drudgery from around the farm house. There are many farms in Ontario, served by Hydro, where similar stories of personal interest could be obtained, and in them there is a wonderful opportunity for farm journals to show the possibilities for making Hydro the means whereby life on the farm can become much more than the daily round of endless tasks.—EDITOR.

OURS is not a show place," the Rothwells of Gilford told us when we suggested that what they had done with electricity in their farm house would make interesting reading for other farm people who want to put more convenience and comfort into their own homes. But we were not looking for a "show place". We feel that most of our readers are not interested in that sort of home; that they want to know how other farmers have used what they have and without unnecessary expense have added improvements that are practical and that actually save work or help to make a happier, more comfortable place to live. This has been the way on the Rothwell farm, and the house as it is now, is an example of an almost ideal combination of the best in the old and the new.

It did not all come in a day or a year, as the present Rothwells were quick to inform us. "Dunbrodie Farm" is named after the ship on which their father, William Rothwell, came over from Ireland in 1847. The third oldest of a family of eleven, he was just sixteen when his father died. There were years after that when he "worked out" to help his mother with the support of the younger children, and saved enough to buy the first fifty acres of "Dunbrodie Farm", to which he moved when he was married. The holding has since been extended to two hundred and forty acres, bearing evidence of the work and care of two generations—one of those fine "old homestead" farms with smooth fields and old trees and a solid, big, hospitable house. It is of the happy, thrifty combination of old things and new in the house that we want to write.

To begin, the house was built over fifty years ago for a family of the old-fashioned size—a house with a large parlor and dining-room, enough bedrooms to accommodate the family and the guests that are always coming and going, a kitchen large enough to set a threshers' table without diffi-

"Dunbrodie" homestead. The flowers did not suffer from the dry spell this summer; the reason is a hydrant at the edge of the lawn.

culty, and off the kitchen a pantry and a washroom.

The bathroom did not come for some years after the house was built; people were not putting bathrooms in farm houses fifty years ago. But it seems to have always been a family tradition to get the best for the home that could be had at the time. So when William Rothwell built the washroom off his kitchen, he put in it a big, copper bath tub. There was no water on tap in the room, but there was a pitcher pump connected with the cistern and the tub had a drain to carry waste water away. And in those days it did not seem much trouble to heat a kettle of water on the kitchen range just a step from the washroom door. Years later when electric power came to the farm and they had water under pressure in the house and a new, complete bathroom with modern fixtures, the old copper tub was taken to use for a shower bath in a summer washroom for the men.

The original washroom is still the year-round washroom with hot and cold soft water and cold hard water on tap. There is so much lime in the hard water in this district that it is not practical to have hot hard water on tap—the lime forms a coating on the pipes. A cupboard for brooms, mops and cleaning supplies is built in the washroom, and a linen closet with shelves wide enough to hold table cloths without undesirable folding. The bathroom is on the ground floor, separated from the kitchen by a convenient hall arrangement. On our farm visits we find women about evenly divided in their opinions as to whether it is more convenient to have a bathroom on the ground floor or upstairs, and it suits this household better to have it downstairs.

The bathroom is only one of the benefits made possible to this house

by the coming of hydro-electric power. A comfortable home had always been one of the objectives of the farm business and with electricity more than paying its way in pumping water, cleaning seed and chopping grain at the barn, it was possible to turn it to use in many ways in the house. Besides the water system they have an electric washer, a combination coal or wood and electric range, a heater, a toaster, an iron, a vacuum cleaner, a furnace blower, a water heater, a battery charger—very much in demand when battery radio sets were more common in the neighborhood—such minor gadgets as electric curling tongs and, of course, electric light. When we asked Miss Rothwell which of these she found most indispensable, it was like asking a child to select one kitten from the flock. She wouldn't want to part with any of them.

"Perhaps the washing machine saves the most actual work," she considered. "We usually have a family of from six to ten in the house. In the summer time, with the family and relatives coming back to the old homestead"—(This is a popular place with children, by the way) "we have six bedrooms in use most of the time. A power washer makes it possible to do what one couldn't manage otherwise, without help, and it isn't always possible to get help in the country."

Which seems one of the strongest arguments for having every possible mechanical labor saver in a farm home. "Hired girls" are not always available; they may not be needed through the whole year; or the family may prefer the privacy of family life without a maid in the house. But in times of illness or extra work the farm woman cannot send her washing to the laundry or order her baking from a food shop. And the farm business is such that hired men, sometimes several of them at a time in rush seasons, must be cooked for and boarded in the home. The most dependable way of lightening the woman's work is to install labor savers that can be relied on, day in and day out, all through the year.

"So you think the electric washer is your greatest help?" we suggested, but Miss Rothwell was not sure about that.

"Perhaps," she said, "it means more in the long run to have running water right at hand—no trips outside to a pump or a cistern, and not to have to save water! Since we put in the electric heater we have all the hot water we want at any hour of the day.

"Electric light, too, apart from the comfort and safety of it, does away with at least fifteen minutes' work every day, cleaning lamps and lanterns.

"The stove? That is another case where it is hard to decide whether we like it more for the comfort it gives or the work it saves. We wanted a combination stove because we still have some wood on the farm, and while we have hot water heating in the rest of the house we depend on the cook stove to heat the kitchen. But all through the summer we cook with electricity and the kitchen is as cool as any room in the house."

It seems a progressive move from the old way of moving the cook stove

All through the summer the cooking is done by electricity and the kitchen is as cool as any room in the house.

out to a summer kitchen, away from such permanent equipment as sink and cupboards, and having to do a lot of extra travelling to and from the kitchen proper just at the time of the year when all the farm housework is at its busiest.

And for actual comfort, Miss Rothwell feels that no piece of electric equipment has been more worth having than the blower in the furnace. It makes it possible to use a cheaper coal than they could burn without a blower, but that is not its greatest benefit. A house as large as this and spread out as it is with an ell or wing, is not easy to heat in severe weather. With a hot water system and a blower in the furnace, they have a steady, even heat at whatever temperature they wish, day and night.

Then this youngest daughter said something that must have been felt in many other families: Her father, who had done everything he could do in his time to make a comfortable home, had died before hydro power came to the district; he had not known what it was to have electric light and all that came with it, but her mother had lived to enjoy them, and one of the things she had appreciated most was the warm house in a hard winter.

Other improvements will come. One of the first is to be a water softener. In a dry season such as we had this summer the lack of rain water for washing has been a serious problem all over the country and particularly in sections where the well water is very hard. So a water softener, such as cities in hard water districts use on a large scale in their town water systems, will be installed beside the pump in the basement of the house, and the water will be softened as it passes through it. It will not cost more than a new, larger cistern, they say, and they will be sure of a soft water supply the year round.

They intend to have an electric refrigerator, too, not just to save steps to the cellar, though that would be a

help, but because it will mean economy in taking care of foods like cream and butter and meat. In the summer time their supply of fresh meat from the beef ring comes once a week and electric refrigeration will be a great help in taking care of it.

Among the charms of "Dunbrodie" homestead are the flowers. When we were there the borders and every nook and corner about the house seemed alive with bloom, though most of the gardens we had passed on the way were badly withered. The secret is a hydrant at the edge of the lawn. They have a well — the well their father dug over sixty years ago, that never fails in the dryest seasons, and because they have electric power they have been able to use a hose to water their flowers. When they want to wash the car they drive it conveniently close and use the hose for this, too.

Perhaps someone is wondering about the cost of all this power for lighting, pumping water for the house and barn, cleaning seed, grinding grain for the stock, cooking, washing, ironing, sweeping, heating water, blowing the furnace fire all winter, hosing the garden in summer. The entire bill averages about eight and a half dollars a month, and the men of the family are sure that this cost is well covered by the work the power does at the barn.

It is not so easy to estimate the money value of work saved in the house. Women usually value a labor saver because of the extra things it allows them to do—interesting things that they might otherwise not have time for. We have mentioned Miss Rothwell's flower hobby. Along with this, and being both mistress and maid-of-all-work in a large farm house, she is active in community affairs—the women's missionary society of the church, the women's institute which was organized at her home two years ago. She also keeps open house for friends and relatives who are constantly coming back to visit at the old homestead. How she finds time for everything may be explained partly by good management and skill in her work, but partly by the help she gets from her household servant, electricity.

A fine combination of old things and new. The "centre table" and small chair (upholstered to harmonize with the new overstuffed chair) have been in the family for over half a century. An electric reading lamp is just outside the picture.

Stories like this might be duplicated in many farm homes where electricity has been set to work. There

are other places with less equipment but where the first essentials to save work and improve living conditions have been provided. But there is still a lot to be done to make hydro power available to more farmers, and in view of what it means to the family it seems to be something worth the interest of every farm woman, and every farm women's organization.

The Eccentricities of Mercury

THE elusive little planet, Mercury, has been known since about the year 500 B.C. Like Venus, it appeared alternately in the morning and evening skies and, at first, was thought to be two different stars. The morning star, the Greeks called "Apollo", the evening star, they named "Mercury"—the Winged Messenger of the Gods. When these stars later were recognized as being one planet, it retained the latter name, which was very suitable on account of its high speed of travel.

Mercury is unique amongst the planets of the solar system in several respects:—

(a) It is the smallest planet, having a diameter about 3,100 miles. It therefore is practically without any atmosphere. Its small size too is probably one reason that it has not been able to capture or hold a satellite.

(b) It is the nearest planet to the sun, consequently—
It is the hottest planet—metallic lead would remain molten on the side facing the sun. It is the most brightly illuminated planet. It is the fastest in motion, travelling at velocities ranging from 24 to 36 miles per second, and making its revolution around the sun in approximately 88 days — more than four revolutions per year.

(c) It has the most eccentric orbit amongst the readily visible planets. While the other planets* travel in orbits which are close to circular form, with the sun near to the centre, this planet follows a slightly elongated path, Fig. 1, having average diameter about thirty-eight per cent. of that of the earth's orbit and with the sun definitely off the centre by about one fifth of the distance to one end of the orbit.

Mercury undoubtedly is elusive, appearing for about two weeks in the morning sky then disappearing for a little more than a month and reappearing in the evening sky—at the opposite side of the sun—after which it disappears again and comes up a month or more later in the morning sky. As viewed from the earth, this planet is never more than 29° away from the sun, i.e.,

*Pluto, the most recently discovered planet, is not included: its orbit may be very eccentric.

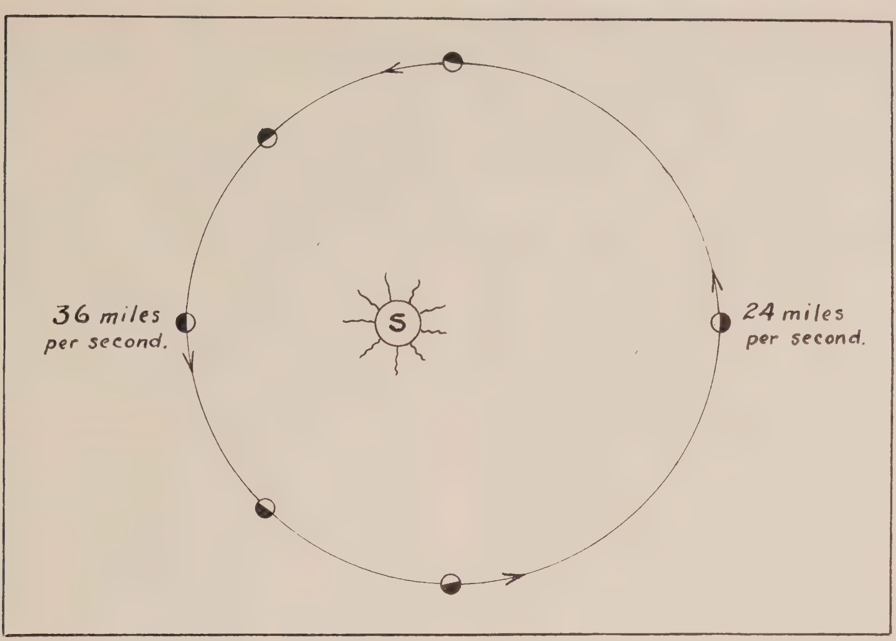


Figure 1—The Eccentric Orbit of Mercury.

not more than two hours difference in rising or setting. It therefore is only seen through a low atmosphere which makes detail very indefinite.

Probably the best time to observe, or to photograph Mercury is during a total eclipse of the sun, Fig. 2. When such phenomenon occurs with

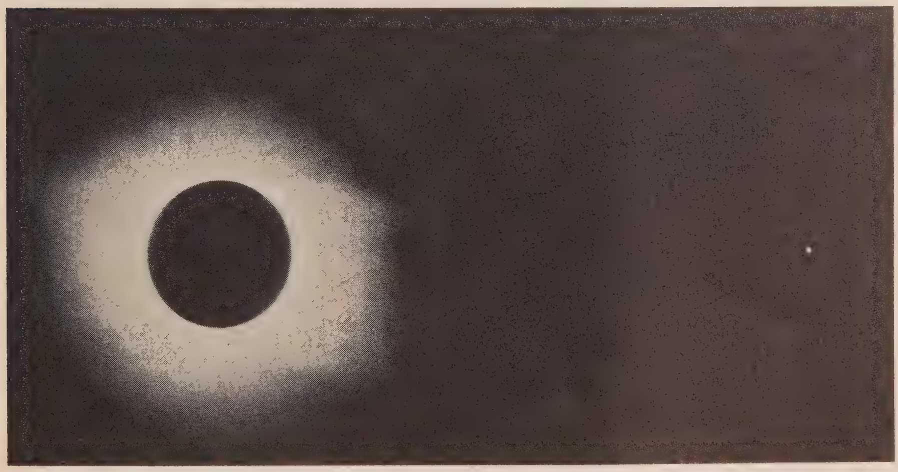


Figure 2—The planet Mercury appeared during the total eclipse of the Sun on May 29, 1900.—Smithsonian Institution.

the sun at a high altitude and the planet well away to east or west, observations should be the best and photographs most satisfactory. On these occasions, however, time is very limited.

Mercury goes through the same series of phases as our moon but reversed in their order, as with Venus. It does not appear very bright, however, as the background sky usually is illuminated by the sun at the time of observation. While passing through the phases, the apparent diameter of the planet varies in a ratio slightly more than two to one.

The following dates are given for the phases and appearances of Mercury during the years 1936 and 1937.

Superior Conjunction —Not visible—	Greatest Elongation East —Evening Star—	Inferior Conjunction —Not visible—	Greatest Elongation West —Morning Star—
Dec. 10, 1935	Jan. 16, 1936	Jan. 31, 1936	Feb. 26, 1936
April 10, 1936	May 7,	May 31,	June 25,
July 23,	Sept. 4,	Sept. 30, 1936	Oct. 16, 1936
Nov. 18, 1936	Dec. 29, 1936	Jan. 14, 1937	Feb. 7, 1937
Mar. 25, 1937	April 20, 1937	May 11,	June 6,
July 8,	Aug. 18,	Sept. 14,	Sept. 30, 1937
Oct. 29, 1937	Dec. 12, 1937	Dec. 30, 1937	

(When the planet and sun cross the meridian together, this is called a "conjunction": "superior" and "inferior" indicate that the planet is respectively beyond or nearer than the sun.

The "greatest elongation" means that the planet is at maximum angle east or west from the sun, and appears in the half phase. It may be seen best on these occasions).

The time period from any given phase until a return to the same phase is approximately 116 days: this is known as the "synodic period" of the planet.

On somewhat rare occasions, there is a "transit" of Mercury—i.e., the planet may be observed crossing the sun's disc. These events occur from seven to thirteen years apart and the planet may be followed as a very small black dot moving from left to right. The last transit that was visible in Canada took place on May 7, 1924: the next transit to be seen here will occur on November 14, 1953. This phenomenon can be only in the months of May and November.

While it is necessary that some planet will be the smallest, one be the hottest and fastest in travel, and one have the most eccentric orbit, Mercury is unique in having seized all of these distinctions for itself but this planet is extremely tantalizing in the manner in which it dodges to east and west of the sun playing, as it were, the game: "Now you see me—and now you don't."

—*F. K. D.*

Some Practical Electrical Tests For Transformers*

By F. K. Dalton, Testing Engineer, H. E. P. C. Laboratories

ELECTRICAL transformers usually are built to well-defined specifications prepared by the purchaser and are required to have certain characteristics and to meet the guarantees given by the manufacturer.

For the protection of the purchaser and for the satisfaction of the manufacturer, and to supply him with design information for future use, it is necessary that each unit be tested. These tests must be so arranged as to include measurements of quantities which enter into the operating characteristics of the units and also to stress the transformer parts sufficiently to prove that they will withstand the electrical and magnetic forces incident to normal operation.

The usual tests applied to transformers include measurements of resistance of windings, losses and temperatures, the checking of ratios and polarity, and the application of over-voltages to prove that the insulation is sufficient. The procedure to be followed in making these tests is fairly definitely stated in the standards of the British Standards Institution, the American Institute of Electrical Engineers and the International Electrotechnical Commission.

It frequently appears desirable, however, to institute some special test for the purpose of determining a feature or characteristic which is not shown clearly in the results of the usual tests. Such tests must be of a thoroughly practical nature and suitable for the test department of a factory with the equipment usually available in it.

The methods of test explained below have proved very convenient and useful in determining the special features of certain types of transformers, which the tests were designed to show, thereby increasing the purchaser's assurance and satisfaction in the units supplied to him.

Distribution Transformers

Distribution transformers of the smaller sizes used for the final step-down to suitable voltages for residential lighting, or for small power loads, are produced in quantity and scattered over the system; they are subject to a variety of load conditions and changes and should therefore be tested for consistency in characteristics.

(a) Arrangements of instruments: For the measurement of core and copper losses, several different arrangements of the instruments in circuit are used at various factories, each requiring suitable corrections for instrument losses. That order of instruments which involves the minimum correction should be preferred

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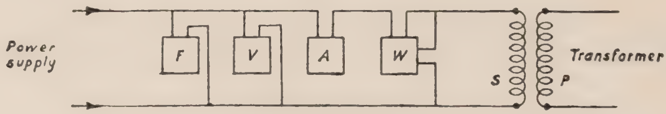


Fig. 1. Arrangement of instruments for core loss measurements.

and used as the standard arrangement, and it may be possible to correct the instruments so that corrections may be applied by adjustment of current or voltage prior to reading the values of the losses.

The arrangement of instruments shown in Fig. 1 merits consideration in this respect. A compensated wattmeter is placed next to the transformer so that its indications are precisely the losses in the unit. The wattmeter is preceded by an ammeter and ahead of this are placed the voltmeter and frequency meter.

In the measurement of core loss, the exciting current is nearly in quadrature with the voltage applied to the transformer whereas the current in the potential coil of the wattmeter is practically in phase with the voltage. These currents, therefore, will be out of phase to such a degree that the latter will not appreciably add to the value of the former in the indication of the ammeter; any correction of current readings would therefore not be necessary. At the same time, the IR drop in the ammeter and current coil of the wattmeter, being in phase with the current, is nearly in quadrature with the voltage applied; the voltmeter indication is thus very close to the applied voltage at the terminals of the transformer, and no correction need be considered.

When measuring copper loss with this arrangement of instruments, a slightly different condition exists. Distribution transformers usually have a low reactance so that the current in the potential coil of the wattmeter may add fairly directly to the copper loss current of the transformer in the reading of the ammeter. The wattmeter, however, is compensated to read correctly the actual losses in the transformer; the difficulty in ammeter reading may readily be overcome by adding directly to the transformer current an amount equal to the wattmeter current, measured at the proper voltage with the transformer disconnected from the circuit, and then adjusting the ammeter indication accordingly.

The voltmeter will read very slightly higher than the true impedance volts and, if desired, may have a correction applied according to the ohmic resistances of the coils of ammeter and wattmeter and the IR drops therein. This, however, is seldom necessary as the impedance of these transformers is not usually considered important except in so far as the individual resistance and reactance are concerned. The effective resistance may be obtained from the wattmeter reading, which, with this connection, is not subject to correction; and the reactance may be found most conveniently and accurately by the use of quadrature voltage on a separate test.

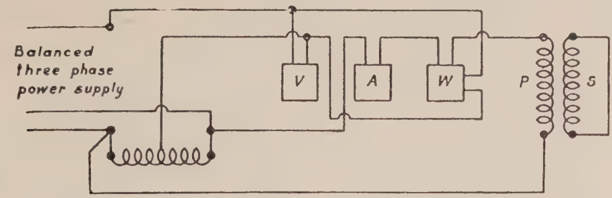


Fig. 2. Circuit for measurement of reactance by quadrature voltage.

(b) Reactance by quadrature voltage: To determine reactance from impedance voltage and copper loss wattmeter readings in a transformer in which the reactance is appreciably lower than the effective resistance, may introduce serious errors due to the personal equation in the reading of the instrument or to the fact that they are not read simultaneously. To attempt to show consistency in reactance in a number of transformers of the same rating by calculating it in this way may be practically useless as the results generally show wide variations.

Another method of obtaining reactance may be used very conveniently with the connections shown in Fig. 2. A balanced three-phase power supply is required for this test and across one phase is placed an auto-transformer with a centre tap. From this phase also, current is supplied through ammeter and wattmeter to the transformer primary winding.

The quadrature voltage for the wattmeter is taken between the third terminal of the three-phase supply and the centre tap of the auto-transformer. The current to the transformer under test is adjusted to full load value on the ammeter; quadrature voltage is applied to the wattmeter and a reading taken. The voltage, which should be 86.6 per cent. of the impedance voltage, may also be read.

From the wattmeter reading alone, at full load current, the reactance is calculated as follows:—

$$\text{Per cent. reactance} = 0.1154 \times \frac{\text{wattmeter reading}}{\text{transformer rating in kv-a.}}$$

For transformers of the same rating, the reactances will be directly proportional to the wattmeter readings. It is, therefore, a very simple matter to check the consistency of reactance of several transformers by comparing only the wattmeter readings on the respective units. This is also a good check on workmanship, for, whereas core losses may be comparable if there be the right amount of iron and good joints, and copper losses and resistances will be comparable if there be the right amount and correct sizes of wire, the reactance will show, immediately, any variations in the placing of coils in relation to each other and whether or not insulation is the same in thickness throughout the group.

In this way reliable reactance readings are of considerable value in inspection work.

There is one caution to be observed, however, in arranging the power supply; the control of voltage must be such as not to upset the three-phase balance. The voltage must be adjusted by generator field control or by transformer taps, or auto-transformers, but not by resistances in the a.c. circuit.

(c) Impedance balance: Where a single-phase transformer is connected for three-wire service, it is important that both sides of the circuit be balanced in impedance of the transformer windings. Transformers have been found which meet guarantees for regulation when connected for a two-wire load but which when used on a three-wire system did not meet these guarantees on one side of the circuit.

It is therefore desirable to make an impedance balance test, applying voltage to the primary winding with only one of the secondary windings short-circuited, taking each of these windings in turn. The test is made at the same time as the regular copper loss test but only one half of primary full load current is required.

The transformers most liable to show an unbalance are those of the semi-shell type with centre core leg where all turns encircle this one leg and the secondary windings are in two groups having the primary winding in the centre with one secondary outside and the other on the inside. If the secondary windings be not properly interconnected, an unbalance is likely to occur. This may be an unbalance in resistance, in reactance or, possibly, in both components with or without unbalance in total impedance. The individual components, however, are the important factors in determining regulation at various power factors.

(d) Heat runs at excessive loads: Under the various load conditions to which distribution transformers are subject, it is desirable to know how quickly they heat on excessive loads. This is more important for the smaller sizes where they supply several customers having ranges and other heating devices that may all be turned on at the same time for short periods. In making a test to determine the rate of temperature rise, the method must be such that the transformer windings are not allowed to become too hot and thus suffer damage. In other words, the run must be cut off sharply as soon as the temperature has reached a predetermined limit; the test then becomes a measurement of the time required to reach a certain temperature or a given rise above ambient temperature.

A method which has proved very satisfactory requires the use of two transformers (Fig. 3). The transformer under test is at the right; the one at the left is an idler to give a replica of the primary voltage, correct as to magnitude, wave form, and phase position, to be balanced against the actual secondary voltage of the transformer under test.

The ammeter and wattmeter carry secondary load current which may be adjusted to any value and held constant at that value. The secondary terminal voltage, V_1, of the loaded transformer, is adjusted to normal rated voltage.

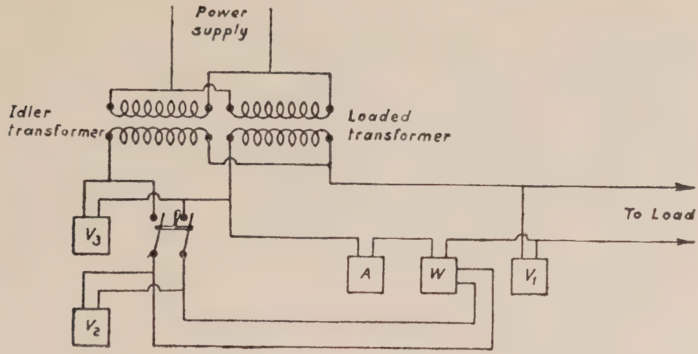


Fig. 3. Special heat run connection.
* V_1 - Secondary voltage.
V_2 - Impedance voltage.
V_3 - Voltmeter to check relative polarity of transformers before closing switch.

The vector voltage difference, V_2, (secondary) between the loaded and unloaded transformers, which is the impedance voltage of the former measured on the secondary side, is applied to the wattmeter potential coil. This instrument W, then reads the product of load current and impedance voltage, namely, copper loss—a value and indication which will rise directly as the effective resistance. The voltmeter, V_3, is inserted only for protection—to insure that secondary windings are in differential connection before applying voltage to the wattmeter.

For the smaller distribution transformers to which this test has been applied, stray losses are considered negligible; so the effective resistance becomes the total of winding resistances, in terms of either winding, and the increase in the wattmeter reading therefore will be a measure of the average rise in winding temperatures.

The following formula will apply: Temperature rise (degrees) = per cent. rise in wattmeter reading $\times$ [234.5 + temperature of windings in degrees centigrade at start of run] /100.

On tests conducted at 300 per cent. load, it was decided to cut off the heat run as soon as a temperature rise of 70 degrees (centigrade) was reached. For a winding temperature of 20 deg. cent. at the start of the run, this required an increase of 27.5 per cent. in the wattmeter indication, when the test was complete. The first wattmeter reading was taken as quickly as possible after the start of the test: this instrument was watched closely, readings were taken at ten-minute intervals and when the required proportionate increase in watts was observed, the run was quickly cut off and hot resistances were measured. The average of temperature rises of the two windings by hot resistances usually checked to within a half degree with the average temperature rise by the watt-

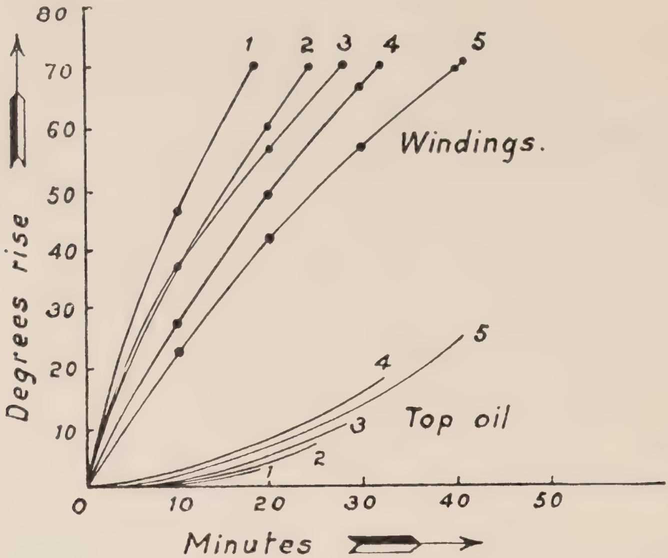


Fig. 4. Typical temperature rise curves of distribution transformers.

meter method. If there were any appreciable difference between the temperature rises of the separate windings, it was then a simple matter to determine, by plotting results, the time for the hottest winding to reach the given rise in temperature.

Typical curves of temperature rise of several transformers at 300 per cent. full load are shown in Fig. 4. In the circuit used, the transformer under load is normally excited but the instrument readings are not complicated by the introduction of exciting currents, or core losses. The effect these have in contributing heat to the windings is, however, included in the temperatures indicated. For loading the transformer, a resistance bank may be used or it may be balanced against a duplicate transformer. In this latter connection, the loaded transformer may be either the driver or the driven unit; the impedance voltage and wattmeter reading remain the same (for a given current).

The ohmic cold resistance of windings and the readings of impedance voltage through the test may be used to calculate rise in resistance, and consequent rise in temperature; the results obtained in this way have been found to check very closely with those determined from the wattmeter readings.

One very great advantage of this method of test is that the rising temperature may be watched and determined at any time during the run without interrupting the test or requiring thermocouples, resistance elements, etc., to be inserted in standard transformers. Several manufacturers to whom this run has been explained and demonstrated

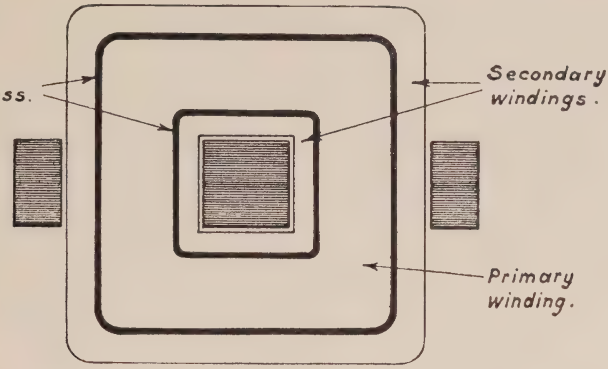


Fig. 5. Arrangement of windings in distribution transformers which may cause radio interference by stresses on barriers.

have adopted it in their factories as a means of obtaining design information regarding the rate of heating of windings and the effectiveness of various experimental duct systems.

(e) Radio interference: Transformers of any size may be a source of radio interference, not only due to loose parts on the terminal boards but also on account of over-stressed bushings or barriers. While bushings have been a known cause, barriers have been little suspected as it was generally thought that a barrier which could withstand specified insulation tests would not cause interference at the lower (normal) operating voltages.

Some rather severe cases of interference due to barriers have been found and thoroughly examined. The use of uncovered mica barriers and an unsuitable arrangement of windings were the causes of the trouble. The offending transformers were replaced by others of the same rating but of different design as to barriers and windings and the interference ceased.

It therefore appears very desirable to test transformers for radio interference supplying a voltage slightly above normal and having tank and windings grounded or isolated just as they will be in service. The transformer is excited as on a core loss test.

The only additional equipment required in the factory to perform these tests is a radio receiver operating within the broadcast band of frequencies and a suitable aerial system exposed to short lines which are attached to the primary windings of the transformer under test. A row of transformers may be tested at the same time.

The placing of a primary winding radially between two groups of secondary windings (Fig. 5), the latter being directly grounded at centre or some other point, is conducive to interference, particularly when the primary is connected to a grounded neutral system. In this case one or other primary lead, and also the corresponding inner or outer layer of primary winding, are at the high line

voltage and the barrier between this layer and the secondary winding will be under full voltage stress: high voltage streamers over the surface of the barrier then may cause very serious interference.

Further, as the rated primary voltages of transformers increase, it is customary to divide the primary winding on a core type transformer into an increasing number of sections. This, however, is a step in the wrong direction when radio interference is considered. The inner layer of the first primary section usually is adjacent to a barrier and the larger the number of sections the higher will be the potential of this inner layer in proportion to the full line voltage. To confine the primary winding to two sections, or, for voltages over about 7,000 volts, to have one section only, appears to be the most desirable design from the point of view of interference.

Transformers with primary voltage ratings of 3,000 volts, or lower, do not usually cause any annoyance by radio interference. The test on transformers of higher primary rating may satisfactorily be made at approximately ten per cent. above normal voltage.

The requirement that transformers shall operate without causing interference to radio reception is now being included in the specifications of different purchasers.

POWER TRANSFORMERS

The testing of power transformers to determine their characteristics is much the same for all ratings and capacities. In comparison with distribution transformers, however, these units usually have higher per cent. reactance and lower per cent. resistance and the power required for test may be larger in proportion to the generator capacities available. These conditions at times cause some complications in test which suggest the advantage of using special methods. There is also a much larger proportion of three-phase transformers in the power sizes.

(a) Heat runs on high reactance three-phase transformers: Where a three-phase transformer is given a heat run, and there is no other unit available to balance against it, it is usual to connect both windings in delta with single-phase copper loss current supplied at one corner of the delta of either winding. For core type transformers, this method may lead to erroneous results, and may even give higher temperature rises than will occur under normal full load operation. This is particularly liable to happen with transformers of high reactance, that is, 10 to 15 per cent.

It would be advisable therefore to measure impedance and copper loss of three-phase transformers by both three-phase and single-phase current supply. For the latter measurement, current is passed through the three phases of one winding, connected in series; the other winding is connected in delta and secondary currents circulate through it; or each phase may be short-circuited on itself.

The single-phase measurement, when reduced to terms of three-phase conditions, gives a higher impedance voltage, and usually a higher copper loss than the measurement made by

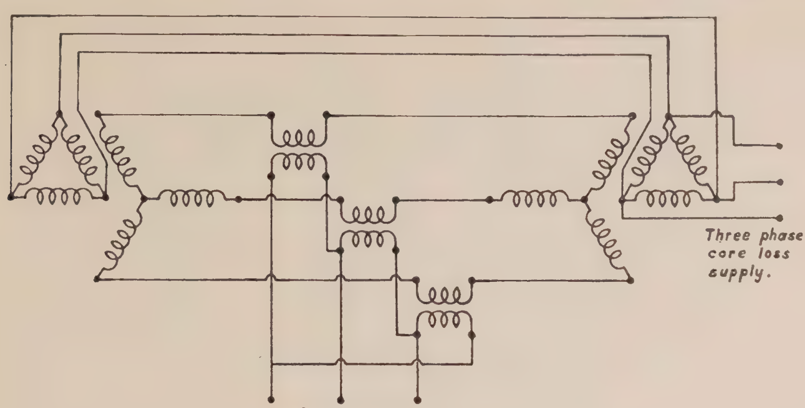


Fig. 6. Three phase transformers connected for "back-to-back" heat run.

three-phase supply. In one instance, the copper loss measured single phase on a high reactance (ten per cent.) transformer was 2.5 times the value obtained by a three-phase supply with the same current density in the windings. Heat runs made on this unit with single-phase circulating currents gave temperature rises several degrees above the guarantee whereas when two of these transformers were placed "back to back" and run with three-phase load currents, connected as in Fig. 6, the temperature rises were nearly twenty degrees less and well within the guarantee.

It was evident here that stray losses with single-phase fluxes reached a value considerably higher than the total I^2R losses, due undoubtedly to fluxes in the three core legs being in the same phase relation and thus being forced to follow return paths external to the core, probably through the upper and lower frameworks and the tank walls, with heavy eddy currents flowing in these parts.

Where copper loss by single-phase measurement is appreciably higher than when measured by three-phase supply, the temperature run should not be made with single-phase circulating currents for the transformer may appear to have failed to meet its temperature guarantees.

(b) Exciting currents and form factors: The exciting current of a transformer depends upon the wave form of the applied voltage. A transformer tested on different generators, or on the same generator with different winding connections, and consequently different field flux densities, will have different values of exciting current though the r.m.s. value of voltage is the same in each case. If, however, the average value of applied voltage be measured by a special voltmeter so that the form factor may be calculated, a relation between exciting current and form factor will be obtained.

When several large single-phase transformers of the same rating were tested in three separate groups, the

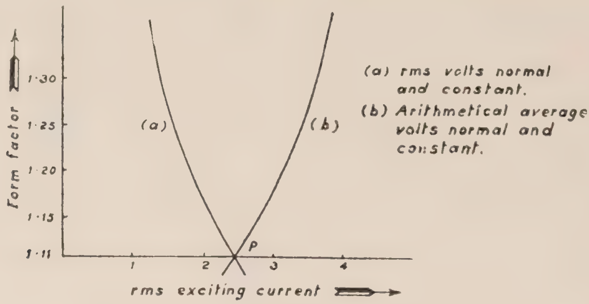


Fig 7. Form factor – exciting current curves of a power transformer.

exciting currents showed wide variations when compared by groups whereas all transformers within any one group were consistent with each other. In checking over test conditions it was observed that the form factor of the voltage waves was different for the three groups.

One transformer was selected and its exciting current measured with all the generator and transformer connections used on the former test, thus giving the various form factors previously obtained. Separate readings were taken, with each power supply arrangement, with voltages normal in each case, as indicated respectively by the "r.m.s." and "average" voltmeters, and readings were plotted to give two curves shown in Fig. 7.

Following down the curve at the left means that "r.m.s." voltage is being held constant at normal value and that the "average" value is increasing (form factor decreasing); exciting current also is increasing. Following down the right hand curve means that the "average" value of voltage is being held constant at normal value and that the "r.m.s." voltage is decreasing (form factor decreasing); exciting current also is decreasing.

It will be observed that both of these curves, when projected, cross the abcissa at the point, P, and that this point indicates the exciting current that would be read if a true sinusoidal voltage wave had been impressed on the transformer.

Readings taken previously on the other transformers were now plotted on these curves and it was found that all were unusually consistent in the matter of exciting currents.

The only special equipment for this test is a voltmeter reading the arithmetical average value of the voltage wave. It is desirable to use this instrument on all measurements of transformer exciting currents and core losses, and especially so when the power required for the test is large in comparison with the capacity of the supply. Where the generator feeds through an auto-transformer to the test panels, there may be opportunity to take measurements at several form factors by running the generator field at different flux densities and stepping the voltage up or down

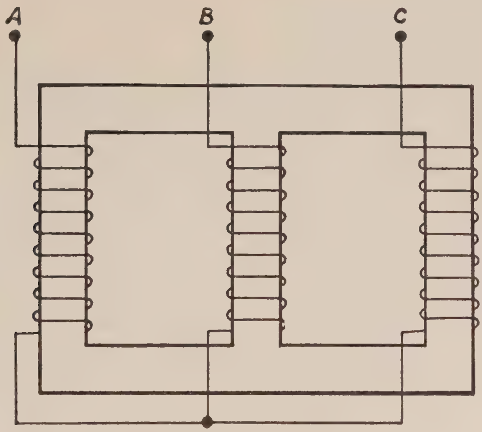


Fig. 8. Three phase losses by single phase measurements. (other winding not shown: must not be closed delta during tests.)

to the required value by the auto-transformer. This test may show that the normal exciting currents of certain transformers are lower, or higher, than those found in tests where the form factor has not been considered.

Similar curves may be plotted to determine correct core loss with sine wave voltage.

(c) Three-phase losses by single-phase measurements: There have been occasions when a factory test department could not make satisfactory tests for lack of a suitable balanced three-phase power supply. Some investigations, therefore, have been made to determine the reliability of single-phase measurements, chiefly of exciting currents and core losses; it was found in the instances under consideration, that the following method gave a very close check on three-phase readings for a core type transformer.

The transformer is required for this test to have one winding in star connection, the other winding being open (Fig. 8). (If this other winding is normally in delta, it should be opened at one corner). Single-phase voltage is applied first between terminals A and B, and adjusted to a value equal to twice the normal voltage per phase of this winding; readings of exciting current and core loss are taken. The same voltage is next applied between terminals A and C, and then between B and C, the readings, both of exciting current and of core loss, on terminals A and C will be observed to be higher than on the other pairs of terminals; the latter should be equal to each other.

In making the measurement on terminals A and B, these two legs of the core and the two connecting yokes are working at normal flux density. A similar condition exists when measuring on terminals B and C. With terminals A and C, however,

two legs and four yoke sections are worked at normal density. If the three wattmeter readings be added together, the losses of every part of the core will be included twice. Half of this sum will be the three-phase value of the core loss.

$$\text{Core loss (3 phase)} = \frac{W_{AB} + W_{BC} + W_{AC}}{2}.$$

In much the same manner, the three exciting current readings are added and the sum divided by $\sqrt{3}$ to give the average three-phase exciting current (line current) for delta connection in normal operation, or this sum is divided by 3 if the transformer is to be operated in star connection.

$$\text{Exciting current (delta)} = \frac{I_{AB} + I_{BC} + I_{AC}}{\sqrt{3}}.$$

$$\text{Exciting current (star)} = \frac{I_{AB} + I_{BC} + I_{AC}}{3}.$$

This method of test for core loss may be used for separation of eddy and hysteresis losses in the core and may even be an improvement on the accuracy of three-phase readings taken with single-phase instruments.

Copper loss and impedance readings may be taken by the same process. The winding to which voltage is applied is connected in star as in Fig. 8; the phases of the other winding are separated and each short circuited. Three single-phase readings are taken as before and the three-phase copper loss will be half the sum of the wattmeter measurements. The three-phase delta impedance voltage will be half of the voltage applied in the single-phase test, *i.e.*, $\frac{1}{2}V_{AB}$ whereas the three-phase star impedance voltage will be the applied single-phase voltage multiplied by $\sqrt{3}/2$, that is $\frac{\sqrt{3}}{2}V_{AB}$. From the three single-phase core loss readings the proportional losses in yoke and leg of the core may be estimated and also, to some extent, the proportionate length of these parts.

AUTOTRANSFORMERS

An autotransformer is a unit in which all windings are electrically connected and the secondary terminals are at taps on the primary winding, or on extensions of this winding.

There is not usually any difficulty in measuring core loss of such a transformer but there are several connections by which the impedance may be measured. With windings short-circuited and voltage applied as shown in Fig. 9 (*a*), (*b*) and (*c*), the core is excited and the results of measurements should all check closely. With connection (*d*), however, the current applied will divide at T. If there were no reactance, it would divide in the inverse ratio of the resistances but the reactance of the windings, and the impedances may also be in the same ratio as the resistances. Excitation of the core would not then be necessary to maintain proper division of current between these two windings.

Connection (*d*) will be found to give a lower reading of copper loss than the other connections, according to the amount of core loss necessary when sufficient voltage is required to be induced in a short-circuited winding to overcome the impedance of that winding and maintain correct current ratios.

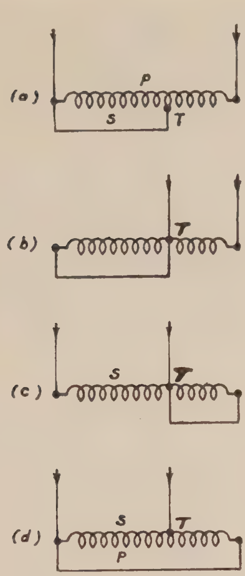


Fig. 9. Connections of auto transformer for copper loss measurement.

Autotransformers are provided sometimes with reactors in the secondary circuit. If these be permanently connected to the autotransformer and enclosed in the same tank without any ready access to the taps on the windings, it will be found that the copper loss with the secondary terminals short-circuited is higher than that obtained when primary terminals are short-circuited and voltage is applied to secondary terminals. The difference will be core loss which is present in the former case but not in the latter, though the total per cent. impedance will be practically the same by either arrangement.

In testing autotransformers for copper loss the connection should be such that core loss is avoided [Fig. 9 *(d)*].

* * * *

All of these methods of test have been used by the writer in factory testing of transformers and have given information which was desired and, in many instances, was essential to acceptance of the units but which the usual factory methods could not give. Certain modifications of the connections shown may be necessary according to the capacities and voltage ratings of the units tested but the methods have been described in a general manner in order that they may be applied as widely as possible.

O.M.E.A. and A.M.E.U.
Convention

at Royal York Hotel, Toronto, Ont.
February 2 and 3, 1937

Better Light—Better Sight in Simcoe

WHILE many municipalities were afraid to take a chance on a new project, eminently successful in the United States but comparatively untried in Canada, Simcoe decided to take the leap and see what would happen. Having a real live Commission, and a Chairman who is really interested in the electrical industry, it wasn't long after a Training School had been held in Toronto that Home Lighting Advisor Miss Olive Thompson was working in the Town of Simcoe, population 5,500.

A good start in anything is sure to lead to something worth while. Art Nichols and his "Eyes Right" show was the starter. The performance was held for two nights and crowds were turned away. The play proved to be both educational and entertaining. The public began to realize there was something more to Lighting than a few bulbs under a rose shade and wanted to learn more about it. To give them this information Miss Thompson would make a "Home Call" free of charge, where many good lighting points were proved to the homemaker, and often new ideas came up for discussion which had never before entered her mind.

Deciding that all those connected with the Local Hydro should meet the Lighting Advisor, and hear something about the story of Better Light for Better Sight, an informal meeting was held. This developed into forming a Sight Saving League with officers, regular sessions and round table discussions followed usually by a "Light" lunch. Such meetings as these were held at intervals, when new ideas and problems were discussed.

Dealers were contacted at the beginning of the campaign and given an idea what Better Light—Better Sight was all about. Some of them were enthusiastic and today they are the ones who have gained the most from the drive.

The Christmas season presented a good time to make the people "Light Conscious" so a few cash prizes were offered for the best decorated homes and Simcoe was all "lit-up" for the holidays.

A pair of demonstration rooms was set up in the Town Hall, one of which represented a typical living-room and the other the same room with the old style lighting improved, and a few new lamps added. Social evenings were held at which the dealers and wives were invited. A "Home Call Skit" was presented by Miss Thompson and Miss Helen Pettit of the office staff, followed by discussion and lunch. The School Board and Teachers were given this same opportunity on another night. In the discussions which came up and general moving around, it was noticed no one cared to go into the old room, but to be comfortable they all went to the "Well Lighted" room.

Illustrated lectures were given at each of the schools and after these the students sent in short essays on lighting, the best from each school being awarded a Study Table Lamp, donated by the Local Commission.

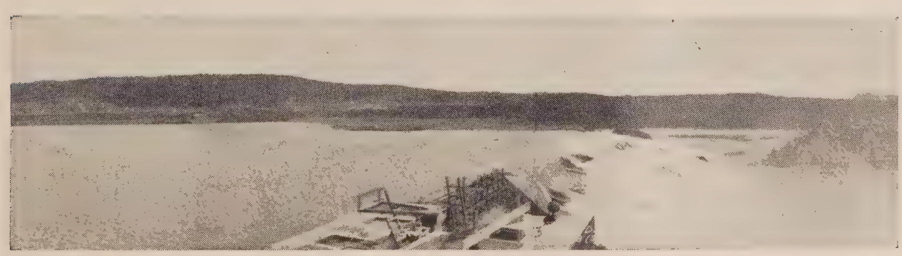
Young People's Groups were also given lectures and through these "home-call-requests" came in. A systematic covering of the residences was also commenced and has been resumed with the coming of the Fall Season.

The work is interesting and entertaining. Family histories could be written in many cases after a Home Call, as we often have to listen to almost a life-story before the Better Light story can be told. Many husbands apparently often only come home to eat and sleep and are ill-tempered and disagreeable, but one look at their "dim and glaring" living rooms, and you decide it's no wonder. Who knows what our Better Light—Better Sight drive may lead to—Happier Homes—domestic bliss and divorces unknown!

Is it not worth considering that the Hydro really owe their customers some information on lighting and some assistance in getting the best out of the energy for which they are paying? Sight Saving through better lighting is of itself well worth while. It will increase load, yes, but there is something in this work which is bigger and better than even business-building. Simcoe thinks it pays on all counts, and so do the dealers' records show that from the time the Campaign started until the Lighting Season was over in the Spring of this year, the dealers had sold:

400 I. E. S. Floor and Table Lamps
500 Other Portable Lamps
300 New Shades
30 Semi-indirect Fixtures
50 Ordinary Fixtures
25 Make-overs
110 Shades sprayed

If we analyze these figures we will discover that 1,415 lamps and shades were handled and Simcoe, with a population of 5,500 people, has approximately 1,100 families, and that means that on the average over 1 lamp or shade was added per family. And the remarkable thing about it is this took place after only half of the town had been canvassed. There is no definite record of the wattage added, but from the number of lamps sold, a great many of which are tri-light lamps, it is safe to assume that the added load will produce a substantially increased revenue in Simcoe this year.



Northern Lights by Hydro

THE Home Lighting campaign sponsored by the Hydro-Electric Power Commission in North Bay, Ont., celebrates its first birthday in November, 1936, and under the care of the Home Lighting Advisor, Miss A. I. Firth, B.A., has grown into a lusty infant of sizable proportions and great promise.

As the local branch of Hydro does not merchandise, the direct advertising of specified lamps depended on the co-operation of the local dealers. Accordingly the first task was to sell Better Light to them and their sales staff, who were given talks on the seeing story and the selling advantages of the Better Sight lamps. A meeting was held to which were invited the dealers, eye-sight specialists, presidents of local organizations, and teachers, and Miss Eleanor Potts of Toronto discussed the new gospel of Better Light and its widely diversified applications in all aspects of living. This led to talks by the local advisor before various women's groups, and to Better Sight activity in the schools. Approximately two thousand copies of the Hydro Booklet, "Let's See" were distributed to consumers.

From November of last year to June, 1936, 162 demonstrations were made in the homes of North Bay. The additional wattage recommended was approximately 43.8 kw., of which approximately 11.8 kw. had been installed by the end of June. During the summer months, activity was suspended, but the yeast was working and from all indications a large percentage of the recommendations are being carried out this fall.

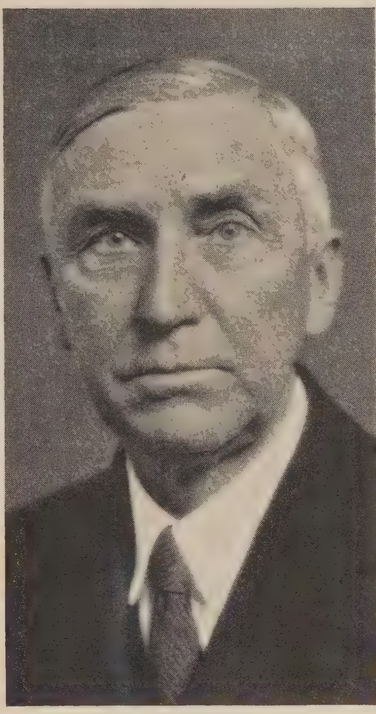
Definite figures on the sale of equipment are not available, but dealers report a decided increase in the sale of I.E.S. lamps, shades and other Better Sight merchandise.

The days are short in the North, and the winters long, so that the need for good lighting is especially great. The response to the Home Lighting activity indicates that Hydro's Better Light-Better Sight plan has filled that need to the satisfaction of the public.

John J. Heeg, Guelph

For more than a quarter of a century, superintendent and secretary of the Board of Light and Heat Commissioners of Guelph, Ontario, John J. Heeg passed away on the morning of Thursday, November 19, 1936. For a number of years back, Mr. Heeg had not been in the best of health and had been more or less under treatment at different times. In February of this year he contracted a cold which turned to a form of influenza, the effects of which he was never entirely able to throw off. During August he became seriously ill and from that time medical skill was without avail.

Mr. Heeg was born in Guelph on October 13, 1874. When he was quite young his family moved to Michigan City, Indiana, and lived there for a time, then returning to Guelph. He was first employed with the Bell



John J. Heeg

Piano and Organ Company, but in 1893, at the age of 19, he was engaged by the Electric Light Company. About 1902 he left Guelph to take charge of the electric plant at Hespeler, Ontario, where he remained for about 18 months, then returning to the Guelph plant. In 1903, the electric plant was purchased from the company by the City of Guelph and Mr. Heeg became plant superintendent under John Yule, who was manager of the Electric and Gas Departments. Upon the death of Mr. Yule in 1907, Mr. Heeg was appointed Superintendent and Secretary of the Commission, which position he held until his death.

As a citizen of Guelph, Mr. Heeg was held in high personal regard and was respected as an efficient public servant. He also had many friends among the staffs of the electrical utilities throughout the Province, being a regular attendant at the meetings of the Association of Municipal Electrical Utilities, of which he was President during 1927.

Surviving are his wife, three sons, six daughters, one brother and five sisters.

As a tribute to his memory we concur with Chairman J. W. Oakes of The Light and Heat Commission who said, "He was a good citizen in the highest sense of the word, a man of fine character, loyal and efficient. As superintendent, he enjoyed the full confidence of the Commission and all of the employees."

A. M. E. U.

Nominations for 1937 Officers

The scrutineers' report showing the results of the primary ballot for nominations officers for the year 1937 lists the following names. The bylaws of the Association provides that "In case a member is nominated for more than one office, he should be considered as having been nominated for the office for which he received the greater number of votes." The names are listed in order of the number of nominating votes received by each, those whose names would appear on the election ballot are marked with an asterisk (*). Each nominee will be given an opportunity of indicating his wishes as to whether his

name is to be placed on the election ballot or be withdrawn.

PRESIDENT—H. F. Shearer*, C. A. Walters*, R. S. Reynolds, O. M. Perry.

VICE-PRESIDENT—R. S. Reynolds*, G. E. Chase, O. H. Scott, C. E. Brown*, V. A. McKillop, A. L. Farquharson, A. B. Manson, R. J. Smith, H. F. Shearer, H. R. Hatcher, M. W. Rogers, C. J. Moors, H. Clegg, L. G. McNeice, J. E. Teckoe, E. V. Buchanan.

SECRETARY—S. R. A. Clement*, W. B. Munro, S. E. Preston*, C. R. Southern.

TREASURER—W. B. Munro*, B. Faichney*, D. J. McAuley, H. T. Macdonald.

Directors (from the membership at large): O. H. Scott*, G. E. Chase*, R. S. Reynolds, W. E. Reesor*, A. B. Manson*, A. W. Bradt*, P. B. Yates*, C. E. Brown, E. V. Buchanan, T. R. C. Flint, R. L. Dobbin, W. R. Catton, O. M. Perry, J. W. Peart, J. G. Hare, O. C. Thal, H. R. Hatcher, C. E. Schwenger, R. O. Quick, J. R. McLinden, S. Buckrell, A. L. Farquharson, C. A. Walters, J. E. Teckoe, C. C. Folger, V. S. McIntyre, J. G. Archibald, F. W. Peasnell, R. J. Smith, T. F. Black, R. B. Chandler, C. E. Kirkby, V. B. Coleman, A. G. Peirson, C. J. Moors, W. D. Stalker, A. E. Ditchburn, Geo. Grosz, A. Jennings, H. G. Hall, C. A. Veigel, E. R. Smitherim, R. S. King, J. E. B. Phelps, Dr. W. E. Weston, Geo. A. Annett, H. L. Pringle, W. G. Breen, R. B. Hanna, I. N. Pritchard, Dr. R. P. Johns, T. Oddette, M. W. Rogers, H. Campbell, C. A. Waterous, C. Kranz, J. E. Brown, W. A. Keith, Geo. A. Reid, W. B. Reynolds, Dr. W. J. Chapman.

DISTRICT DIRECTORS—

NIAGARA DISTRICT—A. B. Manson, R. S. Reynolds, V. A. McKillop*, P. B. Yates, A. W. Bradt, R. Harrison,* J. E. B. Phelps, M. A. Gough, T. E. Bell, W. D. Stalker, E. V. Buchanan, T. R. C. Flint, J. W. Peart, V. S. McIntyre, J. G. Hare, J. W. Bayliss, J. E. Teckoe, O. H. Scott, E. D. Weaver, J. O. Slack, J. Lightbody, H. R. Hatcher, M. E. Jardine, I. N. Pritchard, H. G. Hall, C. L. McMann.

GEORGIAN BAY DISTRICT—C. E. Brown, J. R. McLinden*, H. S. N. Denef*, R. S. King.

CENTRAL DISTRICT—W. E. Reesor, F. A. Sprentall*, G. F. Shrieve*, G. E. Chase, E. R. Smitherim, C. C. Folger, R. O. Quick, Frank Smith.

EASTERN DISTRICT—M. W. Rogers*, R. J. Smith*, W. P. J. Derham, Geo. Phillips, N. J. Douglas.

NORTHERN DISTRICT—C. J. Moors*, R. H. Staford*.

The election ballots will be distributed on the first day of the winter convention of the Association which will be held at the Royal York Hotel, Toronto, on February 2 and 3, 1937. The ballot box will be closed immediately after the opening of the afternoon session on the first day, Tuesday, February 2, and the results of the election will be announced before that session closes.

THE BULLETIN

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Testing and Approval of Electrical Equipment

By W. C. Cale, Approvals Engineer, H.E.P.C. Laboratories

(*This paper delivered before the Toronto Section, American Institute of Electrical Engineers, Nov. 27th, 1936*)

IN tackling this subject it would be better to define it at once, but before I do that I would like to outline the whole scheme so that it may be made as interesting as perhaps such a prosaic subject can be made.

So first we shall ask "What *is* Electrical Equipment?" in this sense.

Second—*Why* is it tested and approved?

Third—*How* is this carried out and where?

Fourth—*Who* submits the equipment and *who* benefits from the service?

I had better say at the outset that the range of my knowledge of electrical testing is quite limited when one considers the whole field of electrical engineering and its scope is restricted to that type of testing which looks for the defects in design and workmanship which may prove hazardous to life or property rather than to tests for efficiency. So it is not on the general subject that I speak but only on that branch of it which is affected by the approvals rules and regulations as enforced by the Hydro-Electric Power Commission.

For a definition of Electrical Equipment we turn to these Rules and Regulations respecting Electrical Equipment, and we find that—"Electrical Equipment shall mean any equipment, machinery, apparatus, appliances, instruments, devices, fittings, or materials used, designed or intended to be used, in the generation, transformation, transmission, distribution, supply or utilization of electric power or energy."

Rather large order isn't it?—very broad, but it was first written by the legal talent for the Power Commission Act, and then expanded for

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Vol. XXIII No. 12
December, 1936

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

these rules. It includes about everything that could, by any stretch of the imagination, be used for electrical work. Theoretically the Approvals Laboratory must be prepared to test any piece of such equipment.

Approval is also defined:—

"*Approval* shall mean the approval of electrical equipment in respect of which a certificate of approval has been issued by the Commission and received by the submittor, and in respect of which such approval has not been subsequently cancelled by the Commission."

The issue of such a certificate of approval must, of course, be based on adequate tests and intelligent inspection following lines laid down by fair and just specifications.

However, there is a practical limit to the scope of the Approvals Laboratory because after all it was just set up to make the work of the Electrical Inspection Department really effective. The Electrical Inspection Department uses as its guide book another book—"Rules and Regulations governing Electrical Installations for Buildings, Structures and Premises", and among the General Regulations we find that the definition of "Electrical Equipment" is trimmed down to something that can be handled with a little more ease, for it says in Rule (b):

"The Rules (of the Canadian Electrical Code, Part I) embodied herein shall not apply, in Ontario, in the case of such electrical central stations and substations, together with their transmission and distribution systems, as are specially designed, built, and used, for the purpose of general public supply; nor to car houses and passenger and freight stations used in the operation of electric railways and supplied with electric current from the railway power circuits."

Now we come to the rule which is the *raison d'être* for these remarks of mine this evening. I quote Rule (e):

"No electrical equipment for use in electrical installations within the Province of Ontario shall be installed or used unless and until it has been approved by the Commission."

Without such a rule there would be no Approvals Laboratory and therefore no Approvals Engineer.

But let us see first "why" approval is required. This will be our second point. Let us imagine if we can an electrical "Utopia" in which—

(1) The manufacturer does not worry about competition or profits but just puts the best material and workmanship into his goods.

(2) The contractor also doesn't fear the "carpet-bagger" competitor but always buys the best materials and employs only competent men and never leaves a job slovenly done; he even solders and paints all the joints.

(3) The householder makes himself familiar with all these good electrical devices and need never be afraid of a fire or a shock.

In such an age, if we ever arrive there, there would be probably no need of inspection of installations or approval of equipment. It is because we haven't yet arrived at that condition of affairs that governing bodies, such as the Commission, have been compelled to write such laws, and it is because of the stupidity and knavery of the few that the really competent are required to help pay the cost of those services which must be set up to require those few to comply with reasonable standards of safety.

We might also look back a few years and see if there hasn't been some reason for rules and codes in the development of the electrical art, as we know it on this continent at least. It was only a little more than fifty years ago when the first commercial generating plant was started in the Pearl Street Station in New York City. The Edison d.c. system carried current to light a few lamps in the stores and offices in what is now the financial centre of our neighbour to the south. A few years later a small plant on similar lines was started in Toronto by J. J. Wright and his colleagues. But even the crude wiring materials in those early installations didn't prevent the new industry making rapid progress. Many of you may recall the open wiring installed on cleats or knobs. Rosettes and cutout bases were of wood at first and perhaps, under proper conditions, gave good service for many years. There was insulated wire, of a kind, with cotton braids and some rubber on it, but perhaps the best insulator used was the air in which the wire was hung or spaced. You may recall, as I do, that arc lamps were used in stores with great success. I have heard that in the early days these were supplied from the series street lighting circuits—5,000 v. or so at the machine. What chances they took in those early days, and I have very vivid recollections myself of shocks obtained in damp cellars when changing the zinc plate and acid cells in the current demand instruments used on many d.c. services, even as late as 1905 in Toronto.

As time went on the experimental materials were replaced by better ones and rules were drawn up for the control of their installation. I understand that the first electrical code was put into effect in New York within six months after that Pearl

Street Station was started up. It was the fire insurance companies who made these first rules because it was necessary to increase their rates unless reasonable safeguards were used in the installing of these new-fangled lights. So gradually the first National Electrical Code came into being to act as a "rudder" to the newly launched electrical industry. It did not attempt to set the pace but the Code makers considered every new method and weighed its merits carefully before adding to the rules clauses which would indicate the minimum acceptable conditions of use. The electrical manufacturers in the U.S.A. also took an active part in the forming of the codes and worked with the inspection and public utility interests, but the inspection authorities were an essential part of the safety movement throughout.

In Ontario, we are familiar with the situation which developed when cheap power became available under the early operations of the Hydro-Electric Power Commission. One of the things which gave concern to the fire insurance companies was the sudden growth in electrical installation work and the increase in the number of manufacturers of electrical devices and in the sale of appliances of a kind which were not properly designed and safe to use. Almost anything that looked like a heating device could be sold to an unsuspecting public in those days. There was, therefore, a strong demand for a better system of electrical inspection and after much discussion and a trial of municipal control of electrical inspection a scheme for provincial-wide control was evolved and put into effect. This placed this work under the direction of the Commission rather than under a department of the provincial government.

The first job to be tackled by the new department was the writing of an electrical installation code. This code although based largely on the National Electrical Code was to be independent of it so that it would more readily meet the needs of the Ontario people and not be subject to changes in which the Electrical Inspection Department would have no say.

So we find that the necessity for providing for the safe use of electricity brought these codes into being. Thus we have the answer to "Why" we have rules which govern and sometimes seem to restrict the development of electrical equipment.

We come logically to the development of the way in which this approval service was begun and is now carried on. The "How" of it:

As I have said these first codes were primarily installation codes but in them were included some construction details which were used by the field inspectors and also by the manufacturers as general requirements for the construction of electrical equipment.

The first detailed specifications outside these general requirements were written on rubber-insulated wire, I believe. A young man in Chicago, W. H. Merrill by name, in the "Gay Nineties" had the bright idea that the manufacture of these insulated wires, which were the necessary "veins" of the ever-grow-

ing electric "body" should and could be standardized and controlled by a system of inspection and labels. He got the backing of the insurance companies and organized the Underwriters' Laboratories and began to test and inspect electrical equipment. Other wiring devices and materials were likewise standardized (but not in so much detail) and brought under this fire inspection service in the U.S.A.

During this early period the National Electrical Code was being used in Ontario and other parts of Canada not only by fire insurance companies as a basis of rating fire risks but by other electrical inspection bodies as well, but it was not concerned so much with accident hazards as with fire risks. So when the first Hydro Rules and Regulations for Inside Installations were written in 1912 by H. F. Strickland, the then recently appointed Chief Electrical Inspector, considerable attention was given to the accident feature of them. The first edition was issued by the Commission in 1913, and said: "The object of the Rules and Regulations is to provide a standard for electrical installations and material, the proper observance of which will eliminate, as far as is practicable and reasonable, risk both of fire and of injury to persons."

These rules, therefore contemplated the setting up of standards for materials as well as for installations but for a number of years the standards and the inspection service of Underwriters' Laboratories (U.S.A.) were depended upon entirely. As Canadian factories began to produce material and equipment for electrical work this dependence upon a U.S.A. testing laboratory became somewhat irksome; and later when British electrical manufacturers sought to enter the Canadian market they were practically deprived of the opportunity to trade with Canada unless they could satisfy the specifications and standards of a foreign country. So the Commission, in 1918, decided to establish an Approvals Laboratory in Ontario, first, to provide for the setting up of standards for material, as already noted, and second, to make it unnecessary for Canadian and British manufacturers to send equipment to Chicago or New York for test and approval. It was not considered necessary to provide equipment and build up a staff large enough to take over all this work at once, but as a beginning two rooms were set apart in the Commission's Laboratory for the Approvals Section, and a staff of six of all ranks taken on.

Underwriters' Laboratories inspection services on electrical equipment were carried on in Canada until 1932, when by mutual arrangement the inspection of all electrical materials manufactured in this country was transferred to the Commission's Approval Laboratory. These services were concerned largely with the inspection of insulated wire and cord, armoured cables and steel conduit. Since that time the Approvals Laboratory has been taking care of practically all electrical work of this nature for the whole of Canada.

Of course, after providing the equipment and staff and the standards it was necessary as well to see

that all manufacturers and importers made their equipment up to the agreed standard. Rules of procedure were therefore drafted and schedules of fees set that would be, as far as possible, fair to the manufacturer as well as the Commission; and regulations requiring the use of the approved materials in this province and, as far as possible, encouraging its use in other provinces were found to be desirable. It was not until 1924, however, that effective regulations for controlling the sale, installation and use of electrical equipment were put into force in Ontario. It was also not until 1932 that the Canadian Electrical Code into which similar regulations had been written became law in the other provinces of the Dominion. As most of you know, the Canadian Electrical Code, Part I, superseded the original Hydro Rules —its first edition in 1927 being followed by others in 1930 and 1935.

To get back to the preparation of the "standards" again: In addition to the work of writing an all-Canadian Electrical Code the Canadian Engineering Standards Association undertook to direct the preparation of and to publish these standards of construction under the general heading of "Essential Requirements and Minimum Standards covering Electrical Equipment" as Part II of this Code. The first one of these specifications to be issued in 1931 was, strangely enough, not one having any connection with wiring devices or materials, but was "Power-operated Radio Appliances", which appliances were just getting over their first "growing pains" at that time and badly in need of some standard for safe construction.

Since that time 31 others have been printed and issued and, in addition, 21 more circulated for comment and acceptance to the Code Committees and the manufacturers concerned. We must give great credit to the hard-working secretary of the C.E.S.A. for his patience at various times with obstinate manufacturers or inspectors, or sometimes Laboratory representatives in the bringing of many conflicting ideas into reasonable shape—sometimes the task seemed almost hopeless. Although B. S. McKenzie was once a mining engineer we believe that his work on the Code has practically converted him into an electrical engineer. At least he says that he can actually remember from one meeting to the next the difference between "dielectric strength" and "overload tests".

So now we come to the "Where" of our introduction.

It is, of course, at the Laboratory where the original report is written because most samples for test are sent in to this building. Sometimes, however, the manufacturer will arrange to have the tests made at his factory if the samples to be tested are bulky or the line is very extensive. In such case he must provide the test equipment and pay travelling expenses of the engineer to and from his plant.

Those of you who have had an opportunity of visiting the Laboratory will recall that the Approvals Section is, perhaps, conspicuous by its lack of any large or expensive pieces of equipment. We have the use of such

of the testing equipment in other sections of the Laboratory as may be required, but we usually manage to get along very nicely with a few test benches, some electrical indicating instruments and rheostats and, of course, the odd slide rule, pliers and screw-driver. Sometimes a hammer and a vise are required to dismantle a stubborn appliance so that its internal workings can be inspected. We have regulated a.c. power supply at both standard frequencies and also direct-current, for load tests on devices and heating runs on appliances. High voltage tests for dielectric strength can be applied at any voltage up to 300,000 volts if required.

In the chemical section tests for galvanizing or for other protective coatings are made. Sealing compounds are tested for softening point and oils for flash-point. Flame-retarding compounds are given a repeated flame application at stated intervals to insure that they will give protection to the insulation to which they have been applied. Rubber and other compounds are analyzed.

In the Physical Section, the physical properties of rubber, its stretch and ultimate strength are determined. The behaviour of insulation under conditions of sharp bends, exposure to water and to severe cold are determined. The resistance of braided or other coverings to standard abrasion tests is determined in addition to the detailed inspection of the make-up of such coverings. Clamps and fastening devices are tested for strength.

These are all more or less routine tests as you will note. The interesting (and often the head-achy) part of the Approvals inspection work is found in the infinite variety of appliances for the utilization of electricity in some form or another which are submitted during the course of a year's work. Looking back over the past year I have noted a few of the interesting and the queer ones:

Short-wave diathermy machines (fever machines), machines for diagnosing disease by sensitive instruments, a machine for restoring circulation to frozen feet, another for encouraging, also by stimulated circulation, the growth of hair on bald heads (some members might like more details of this one), devices for the beauticians' parlour, an electric blanket, an electrically-heated rolling pin and even a sitz bath with a built-in heater was submitted. Traps for insects and for rats, electrically-operated musical instruments in the form of guitars, vibraphones and complete wave-organs (which threaten to displace the pipe organ in a few years) have also been submitted, in addition to amplifiers for hearing-aid devices for public address systems and for the use of the salesman (he is even relieved of the burden of putting on a talk to go with the pictures of the latest car or newest mining property—the machine does it all). These items just indicate the "spicy" ones. There is plenty of just plain, hard slugging away at ordinary things like sockets, switches, plugs and other wiring devices, motor-operated washers, refrigerators, ironers and electric tools, welding machines and transformers, fuses and

circuit-breakers, signs, portable lamps and fixtures.

The Laboratory Report, when satisfactory, is called the "Final Report" but in reality it is not final, for so long as the manufacturer continues to use the Approvals Service and to sell his goods in this province other inspections and reports will be made annually or oftener on his product and usually at the factory. These examinations are, of course, required in order to assure the Commission that the quality of the product is being maintained to the standard agreed upon in the "final" report. If this were not done the temptation to substitute cheaper and, therefore, in most cases, poorer material or parts would be too much for many of the manufacturers, I am sure. Competition in the manufacture and sale of electrical appliances and devices is very keen and I am firmly convinced that without the standardizing and stiffening effect of the Approvals Service many manufacturers would have to give up the struggle altogether. So we come to my last point:

Who benefits from the Approval Service?

(1) We have just noted the fact that the manufacturer usually benefits; "Usually" because there is the case of the manufacturer of a high quality product who complains that the standardizing of electrical goods on a minimum acceptance basis, and the use of the approval label on the cheaper types as well as on the more expensive ones makes the better lines harder to sell. In most cases, however, the devices or appliances which are made in large quantities can be made better and with greater assurance of fair competition under the specifications and regulations of the Approvals Service than they could without it.

(2) Undoubtedly the electrical inspectors throughout the country benefit from the fact that electrical devices are standardized and listed as approved. It is a comparatively simple matter to make sure that the parts of an installation are safely constructed when it is only necessary to refer to a printed approval list. This list, at the present time, contains approximately 3,000 printed cards, 2,200 of them being summaries of reports made in the Laboratory and still under active reinspection service. On these cards are listed literally thousands of electrical devices and appliances in addition to the many varieties of wiring materials which are used in installation work and which the inspector meets every day.

(3) The electrical contractor and the dealer benefit because they also can depend upon the device or material which bears a label or the listing number as having passed the requirements for safety. They can install these devices and know that the electrical inspector will accept them.

(4) But most benefit is derived from this Approval Service by John Public, his wife and kiddies, in his home and at his business. He can rest assured that when his house is wired and fitted up for electric service, with approved equipment it is

safely done, and that he is going to get reasonable length of satisfactory service out of the many appliances which he will want to put into his up-to-date home. He can also be certain that no matter what new-fangled electric idea some crazy inventor will bring along that it will be thoroughly investigated, tested and approved before it will be offered to him for use in his home or business. He looks for safety first in his business too, and the Approvals Service means safety first in the electrical equipment which he uses there as well as in his home.

Use of Electrical Appliances in Ontario Grows Apace

IN no branch of the electrical industry has there been such a constant growth as in that of domestic electrical appliances. The depression, so-called, has had little apparent effect on the steadily increasing numbers of large and small current consuming appliances which Hydro customers are using in their homes. For a few years the rate of increase of some of these appliances was slowed up. This applies particularly to electric ranges and the cause of this undoubtedly can be attributed to the fact that a large number of people who had been using electric ranges, being forced to go on relief, had to relinquish this form of cooking for some other method, because their relief allowances would not cover the cost of electricity for an electric range.

The growth in the use of water heaters seemed to be similarly affected, although a rapid increase was produced by the introduction of the Free Hydro Flat Rate Water Heater and Booster.

As an evidence of the extent to which Hydro customers are making use of the modern electrical appliances, Table No. 1 is submitted herewith showing the number of electrical appliances in use at the end of 1934 and at the end of 1935, giving also the estimated saturation in each case.

In studying these figures it will be seen that a substantial increase has attended the use and installation of electric ranges, hot plates, washers, water heaters, refrigerators, furnace blowers and radios during the past year. All of these are the more modern appliances; that is to say, owners of modern homes recognize the desirable characteristics of complete electrification and take advantage of them when building or remodelling their homes.

A further study of this table reveals the fact, however, that in the case of quite a number of appliances there are still a large number of Hydro customers who are not enjoying the use and economies of these modern conveniences. Only 27 percent of Hydro customers have electric ranges and only 40 percent are washing by electricity. Now, practically

TABLE NO. 1 SHOWING ESTIMATED NUMBER OF MAJOR ELECTRICAL APPLIANCES IN USE AMONG DOMESTIC HYDRO CONSUMERS AT END OF 1934 AND 1935

Appliances	Number		% of Saturation	
	1935	1934	1935	1934
Electric Ranges	129,696	122,794	27.27	26.1
" Hot Plates	71,027	66,282	14.93	14.1
" Washers	190,574	183,081	40.07	38.9
" Vacuum Cleaners	137,361	134,323	28.88	28.1
" Water Heaters, Flat Rate	34,653	28,994	7.28	6.2
" Water Heaters, Metered	41,054	36,693	8.63	7.8
" Grates	31,099	32,607	6.54	6.9
" Air Heaters (Portable)	139,041	140,505	29.23	29.9
" Ironing Machines	7,960	6,841	1.67	1.45
" Irons	444,582	439,765	93.48	93.6
" Refrigerators	59,886	51,309	12.59	10.9
" Toasters	254,295	245,283	53.47	52.2
" Grills	44,387	42,869	9.33	9.1
" Furnace Blowers and Oil Burners	18,225	12,986	3.83	2.7
" Air Conditioners	1,158	733	.24	.15
" Radios	326,805	285,440	68.71	60.7

Number of Domestic Consumers at end of 1935—475,604.

every family does cooking of some kind or other, and it can be proved that cooking by electricity is as economical as cooking by any other method, all things taken into account; and why so many people insist on wearing themselves out—this applies particularly to the housewives—by washing with old-fashioned methods when electric washers can be obtained so cheaply, is hard to understand.

Then take electric water heaters, while there has been a very marked increase in their use during the past two years, there are still a vast number of people who do not appreciate the value of continuous hot water service. Here again, it is a case of the housewife getting along at the expense of youth and beauty to save—what?

Electric refrigerators seem to be coming into their own at last, and it is little wonder, because there is, outside of radios, no electrical appliance which enjoys the number of retail outlets that the electric refrigerator can lay claim to, and there are few electrical appliances whose convenience is so easily appreciated as that of an electric refrigerator. It seems that the only thing that holds people back is the initial cost, and this is being reduced periodically, so that before long every Hydro customer should be a user.

The outstanding example of rapid growth is that of the electric radio, and it is little wonder that this appliance has increased in use as it has, because of the many, many advantages of having it in the home.

TABLE NO. 2 SHOWING SATURATION OF MAJOR ELECTRICAL APPLIANCES IN USE BY DOMESTIC CONSUMERS AT END OF 1935 IN EACH SYSTEM

	All Systems	Niagara System	Georgian Bay System	Eastern and Nipissing Systems	Thunder Bay System
Electric Ranges	27.27	27.51	17.07	27.66	41.58
" Hot Plates	14.93	13.03	26.0	16.41	50.77
" Washers	40.07	41.85	34.86	29.34	53.08
" Vacuum Cleaners	28.88	31.25	13.51	19.34	37.57
" Water Heaters, Flat Rate	7.28	7.71	1.77	5.05	19.29
" Water Heaters, Metered	8.63	7.71	6.78	13.80	16.0
" Grates	6.54	7.34	1.46	3.75	6.52
" Air Heaters (Portable)	29.23	30.97	16.27	23.44	32.6
" Ironing Machines	1.67	1.84	.9	1.05	1.73
" Irons	93.48	94.26	83.84	91.5	100.0
" Refrigerators	12.59	14.06	7.09	7.13	4.84
" Toasters	53.47	52.50	50.3	58.27	68.07
" Grills	9.33	7.22	12.59	20.27	12.28
" Furnace Blowers and Oil Burners	3.83	4.19	2.69	2.5	1.37
" Air Conditioners	.24	.25	.07	.27	.18
" Radios	68.71	70.46	58.3	61.74	72.6

In order that we may study the saturation of electrical appliances in various parts of the Province another table is submitted, Table No. 2, which shows how it looks by systems.

As you know, the Hydro System as a whole is divided up into four general systems, the Niagara, Georgian Bay, Eastern and Thunder Bay Systems, and if we examine the figures of this table we will find that the Thunder Bay System stands out above all others in nearly every case, refrigerators and furnace blowers being about the only exceptions. Of course, one explanation of this phenomenon is that the Thunder Bay System consists of two large cities and one or two villages, and there being no gas competition, and further, since the people of this district are progressive and the cities have been growing, the natural trend has been toward the use of modern electrical appliances in the home, and as our records show the use of appliances in cities and large towns is greater than in the smaller communities, we would naturally expect that the overall saturation would be high. Another contributing factor, of course, is that in this district the rates have always been fairly low and offered considerable inducement to Hydro customers to take advantage of the convenience of Hydro power.

To show the rate of growth in use of the various important appliances during the past eleven years, Chart No. 1 has been produced.

This shows graphically the effects of the depression, also the effect of stimulation which has been provided by various means. If you will look at the curve representing electric ranges it will be seen that between 1934-35 there is a distinct upward

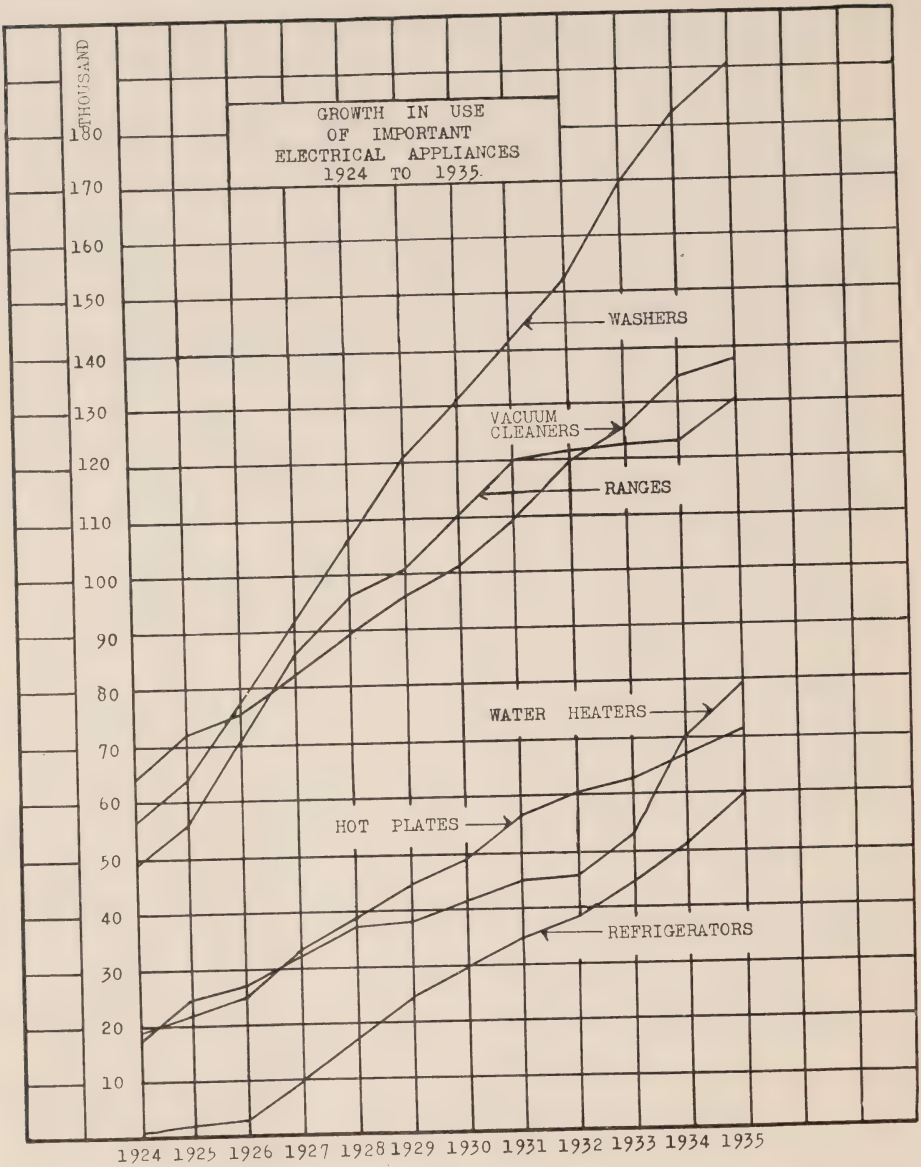

Chart No. 1

trend after three years of practical inactivity. This is due, undoubtedly, to the Hydro-Electric Range Campaign and to some extent to the bringing back into use of some electric ranges which had been discarded because of the depression and the inability of Hydro customers to keep them up. The effect of the Hydro Flat Rate Water Heater Campaign is also graphically shown. There never was such an increase in the use of

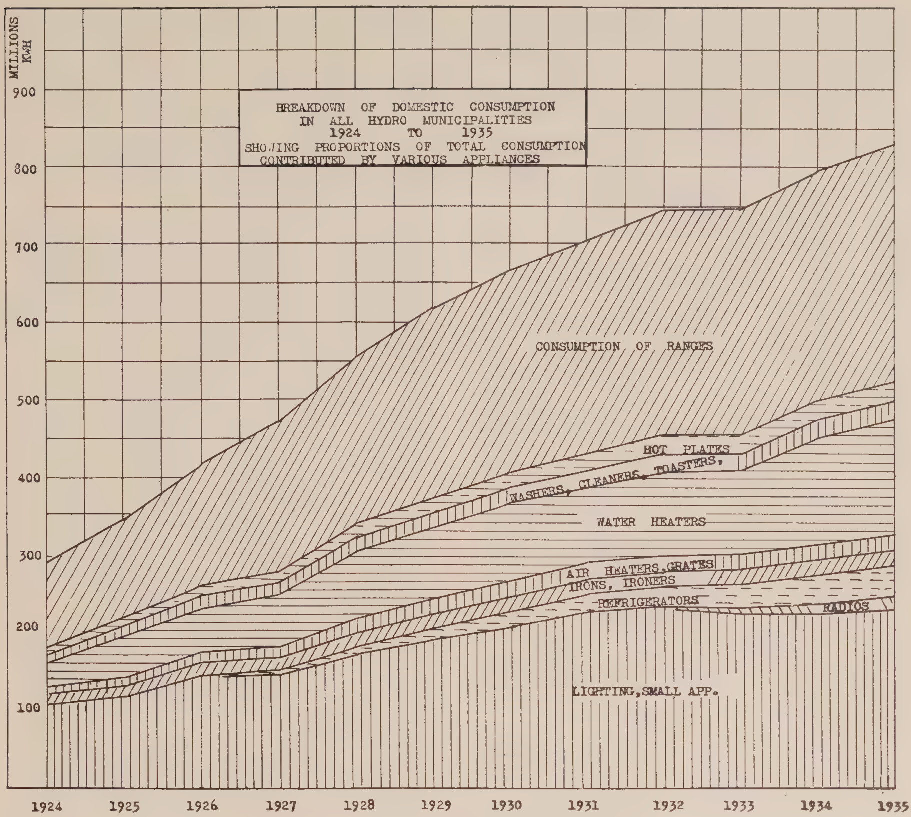

Chart No. 2

water heaters as during the past three years, although there is still much room for improvement.

The curve applying to electric washers is an interesting one, showing that from 1924 to 1935 there has been almost a uniform rate of increase in the use of this appliance, and this is due, undoubtedly, to the untiring efforts of the washing machine industry. They never let up, and the results of concentrated and continuous effort are reflected in this chart.

Another interesting curve is that of electric refrigerators. It shows a gradual rise in the rate of installation, and we have reason to believe that there are really more electric refrigerators in use than are shown by this chart and by our tables, because it is difficult to secure an accurate record of the number of refrigerators installed each year.

The growth in the use of electrical appliances is revealed in the gradual increase in the consumption of electricity by domestic users of Hydro, and to show the relative importance of the appliances and to compare the consumption of these appliances with that required for lighting, Chart No. 2 has been produced.

In this chart an attempt has been made to estimate the average annual consumption of the various electrical appliances in use. It will be realized, of course, that it is practically impossible to arrive at an exact average for each and every appliance, but the figures used to produce these curves are based upon averages which are recognized by the electrical industry as nearly correct as can be obtained.

The growth in the annual consumption of domestic users, all systems, is shown as the upper limit of the chart, and this has been broken down into its component parts. From this chart it will be seen that the electric range, water heater and lighting are the principal factors involved in providing this consumption, and the rapid increase in the use of ranges and water heaters is showing itself in the increased consumption.

It might be interesting to produce a curve which would show the effect of complete electrification of all of the homes of the Province. Of course, it is too much to hope that every home in the Province will some day be completely electrified, but somewhere between the saturation of today and the ideal lies a goal to which the electrical industry should strive, not only for its own good, but for the good of the people at large, and every branch of the industry should co-operate to the fullest possible extent to achieve this goal.

Augustus Hobbs, Elora

On the evening of Monday, December 14, 1936, death came suddenly to Augustus Hobbs, Chairman, Elora Hydro-Electric Commission. He had been at business on that day, apparently in his usual health, and had spent the evening at home. Shortly after retiring he was taken ill and in about ten minutes passed away due to a heart seizure.

Mr. Hobbs was born at Oshawa in 1866. As a young man he went to Tillsonburg, where he entered the hardware business as a member of the firm of Foster and Hobbs. In 1893 he moved to Elora, where he opened a hardware store, and from that time until his decease he carried on business there. He was diligent in his business and built for himself a reputation for reliability.

During his long residence in Elora, Mr. Hobbs also took an interest in public affairs and had a part in recreational and other enterprises of the village. For a number of years he was a valued member of the Board of Education and of the Village Council. In 1923 he was elected to the local Hydro-Electric Commission where he served until his death, having been Chairman from 1931.

In Hydro affairs he was always very progressive and up-to-date in his ideas, with the result that the Elora Hydro System experienced years of success in the serving of its consumers during his tenure of office. All his dealings with the officials of the H.E.P.C. were congenial and co-operative.

Mr. Hobbs is survived by his widow and two sisters to whom we extend our sympathy in their bereavement.

Treatment of Water for Domestic Use in Isolated Locations*

By V. Voaden, Assistant Engineer, Elect. Eng. Dept., H.E.P.C. of Ont.

AT the Commission's Alexander, Eugenia and Abitibi Canyon Generating Stations the river water which is used for domestic purposes is now chlorinated automatically with chlorine in a new form called hypochlorite.

The hypochlorite costs about six times as much as liquid chlorine which is used ordinarily but the feeding equipment is about one-fourth to one-tenth the price. Generally speaking, so little of the hypochlorite is required that communities up to about 3,000 population may find it more economical than liquid chlorine.

The hypochlorite is a white powder. It does not deteriorate, is easy to handle and readily dissolves for feeding as a solution.

The Commission's experience with this and other chemicals, filters, etc., may be of interest to small municipalities, hamlets, summer hotels and the like where a small domestic supply may have to be treated.

The chlorine dose is adjusted manually in the Alexander and Eugenia hypochlorinators by a valve of special chlorine-resisting steel. The chemical feeders at the Abitibi Canyon have solution passages of constant size and the dose is adjusted manually in ten steps by changing the speed at which the inverted U syphon is lowered by a telechron motor. Both types start and stop automatically.

The Nipigon River water at the Alexander Generating Station requires chlorination only. The hypochlorinator is unusual in that the solution flow is automatically adjusted to the fluctuating water demands whilst the dose is maintained as set by the valve. This feature involves the use of a venturi tube in the water main and a hydro-pneumatic tank in conjunction with the hypochlorite solution tank and valve, all of which are under pressure. An additional feature is the opening of a relief valve in the venturi by-pass so that large water demands, such as might occur during a fire, may be met without excessive loss of pressure.

At the Eugenia Generating Station the Beaver River water is treated with two chemicals and filtered. The water is first treated with alum and then filtered under pressure and at a constant rate to a storage tank from which it is pumped to a hydro-pneumatic storage tank which supplies the distributing mains. The hypochlorite solution is drawn into the pump suction pipe only while the pump is running to maintain the pressure called for by the pressure switch. At other times the hypochlorite flow is stopped by a rubber check valve which is closed by water pressure from a small tube connected to the pump discharge.

*This report was prepared for the Commission's Research Sub-Committee on Water Treatment of which the author is secretary.

The Abitibi River water is a muddy brown colour, exceptionally high in organic matter and very corrosive. Five chemicals are used, namely, alum, activated carbon, soda ash, ammonium sulphate and hypochlorite. These are fed by four feeders. The activated carbon which is a finely divided black insoluble powder is kept in suspension in the alum solution by a stirrer which operates continuously. Other equipment includes strainers, mixing tube, settling tank, filter, pump well and pump, through which the water passes in the order named and at a constant rate to the elevated tank in the colony.

The alum dose averages about six grains per Imperial gallon compared with one-quarter to two grains in Southern Ontario and has fluctuated between two and ten in a few days due to run-off, rainfall and sluice gate operation. The colour of the treated water can be maintained at less than 30 compared with nearly 200 for the raw water.

Soda ash is used to make the water alkaline and so prevent corrosion of the piping. A pH of 7½ to 8 is maintained.

A hypochlorite and ammonium sulphate dose of about one part per million of each is required to kill bacteria in doing which all the organic matter in the water is "burned out". The "residual chlorine" after this is completed is maintained at two-tenths to three-tenths of a part per million as determined by the orthotolidin test. The liquid chlorine dose prior to the installation of the water treating system was five to eleven parts per million compared with one-quarter to one-half part per million for many communities on the lower lakes. The ammonium sulphate prevents phenol tastes and reacts with the chlorine to form chloramine and prevent chlorinous tastes.

An activated carbon dose of one-half part per million has largely prevented the formation of scum on the settling tank during the summer and at no time did the water have an objectionable taste.

The cost of chemicals per thousand Imperial gallons of water treated may vary from about one-quarter of a cent when a small dose of hypochlorite only is required, to five or six cents when several chemicals are used and freight charges are high.

O.M.E.A. and A.M.E.U.
Convention

at Royal York Hotel, Toronto, Ont.
February 2 and 3, 1937

Air Conditioning Steadily Gains in Popularity

By Editor, J. Murray Muir, in "Electrical Digest"

SOME six or seven years ago the phrase "air conditioning" was a comparatively new one, and what the term embraced was, to say the least, extremely vague. It was a new idea, however, and many greeted it as the Prince Charming who was to awaken the Sleeping Beauty of the depressed industrial world.

The early enthusiasts, unfortunately, were better optimists than they were prophets and, thanks to saner and perhaps more conservative minds, air conditioning was not shot, rocket-like, into the world to momentarily sparkle and then fade into the night, but allowed to grow in a more normal manner that will, it is reasonable to expect, mean a long, prosperous and happy life.

Early general impressions of conditioned air seemed to be confined to moisture content and coolness and, lacking a very definite goal, true air conditioning narrowly missed getting off to a poor start. Sensing the crying need, heating and ventilating engineers gave the matter serious thought and, as a result, finally framed a definition, which, to all intents and purposes, is serving as a guiding start to those who are seriously seeking or promoting true air conditioning. This definition reads as follows:

Air conditioning is the simultaneous control of all, or at least the first three of those factors affecting both the physical and chemical conditions of the atmosphere within any structure. These factors include temperature, humidity, motion, distribution, dust, bacteria, odors, toxic gases, and ionization, most of which affect, to a greater or lesser degree, human health and comfort.

From this it should be apparent that air conditioning, as is now accepted, is a complete process, and not a nibble here and there at partial treatments. This does not mean that the individual steps, in themselves, will not add to the comfort of living, because they will. It does mean, however, that a full measure of comfort cannot be derived unless the various components are linked together in proper sequence.

While escaping, as said before, a meteoric growth, the air conditioning industry, even in the short period of its existence, achieved a magnitude which cannot be disregarded. Complete Canadian statistics, unfortunately, are apparently not to be had, but from a questionnaire recently sent out by a committee of the Canadian Electrical Association to thirty-four companies believed to comprise the source of air

conditioning equipment in the Dominion, replies received indicate that up to the end of 1935 the number of Canadian installations totalled 413, representing a total load of 8,781 h.p. and an approximate installed value of $1,060,000. From these figures the committee, assuming that the 413 jobs represented but approximately 65 per cent. of the number actually installed, came to the conclusion that there must have been in the neighborhood of 600 installations made to the end of last year, with an installed value of about $1,600,000. And this, it might be pointed out, during depression years!

The home provides one of the most fruitful fields for the air conditioning engineer, not only on account of the number of homes but because of the measure of health and comfort that can be provided. Another factor which has a considerable bearing is that those close to the picture claim that between 75 and 80 per cent. of the homes in Canada possessing central heating installations, are heated by warm air systems, thus tending to make them easily and peculiarly adaptable to air conditioning installations. The age and capacity of the heating system, will, naturally have a limiting influence.

Extensive investigation by independent authorities has definitely established that the relative humidity in the average Canadian home may, during severe winter weather, be as low as 10 per cent., and that relative humidities of 20 per cent. or less are very common even under normal winter conditions. It has also been established that during this season the dust content of the air is much higher than normal, and that the temperature distribution throughout individual rooms is not only unsatisfactory but that variations of from 15 to 20 deg. fahr., between the ceiling and floor are the rule, rather than the exception.

To correct these three conditions in winter time, therefore, it is obvious that the conditioning equipment must be designed to so humidify the air of the home that it is held at the proper relative humidity; that it include a means of promoting a gentle circulation of the air, thus preventing the stratification at different temperatures; and that it must also be capable of filtering the air circulated so that entrained dust particles are removed.

Another, and perhaps equally vital essential is that the cost of the air conditioning equipment be within the limits of what the householder considers a reasonable and justifiable amount. Here, undoubtedly, is where the present bottleneck exists, for air conditioning is still regarded by a large proportion of householders as being a luxury.

In 1907 there were 2,130 motor cars owned in Canada. Today the number is near the million and a half mark. In 1907 and even in 1917, the auto was bought as a luxury. Today the motor car is recognized by practically every owner as being a necessary adjunct to comfortable living. With mass sales, production costs have been lowered and this, in turn, has speeded up the

transition from the luxury to the necessity viewpoint.

With air conditioning, likewise, it is largely a matter of whether the buyer looks on it as a luxury or a necessity. The changing from one viewpoint to the other will, as in the case of the automobile, be only a matter of time and education.

The buyer of air conditioning equipment today is very much in the same position as the buyer of a pair of shoes. He may purchase them ready-made for as low as $2.00 a pair; or he can spend $15.00 for a pair made to his especial measurements. Each will be a pair of shoes and will cover his feet, but here the similarity ends. The shoes that are made to a price will probably only fit him at spots and will possibly dissolve in a pulpy mass in the first real storm. The made-to-measure shoes will last for several years and the wearer will enjoy foot-comfort the whole while. It all boils down to the old adage that you cannot get something for nothing in this world.

That the man on the street is rapidly becoming conditioned-air-minded is clearly shown by the fact that the operators of stores, theatres and railway trains are today being forced to install air conditioning equipment in order to hold their business. It is only a matter of time when the same man on the street will want to walk into the same comfort in his own home. Already plans have been made by groups of business men to build a considerable number of modern, low-priced houses which will contain air conditioning as one of the main features. Real estate men prophesy that before long it will be just as hard to dispose of a house that does not possess air conditioning as it once was to dispose of the house without a furnace.

To the electrical industry, air conditioning may not be the largest consumer of power but its magnitude is by no means small. If six hundred existing installations represent a total load of 13,500 h.p., what the load will be when ownership of air conditioning equipment reaches the same proportions that automobile ownership does today, is only a matter of simple calculation.

Apart from the actual electric load, the electrical industry is also especially interested in two vital components of any system, namely the actuating motor and the controls. In the early stages the motor for air conditioning work was taken for granted so long as it was reasonably quiet and free from radio interference, but this is changing because the large condensing units, blowers and pumps of the modern system require substantial amounts of power.

For complete satisfaction of operation of any air conditioning installation, control is the heart of the equipment. Controlling relays, thermostats and humidistats should be entirely automatic in operation and for this reason it is also becoming increasingly necessary for full co-operation between the air conditioning and electrical engineers.

The Mysteries of Mars

MARS, the ruddy little planet that is named, on account of its colour, after the mythical God of War, has been enshrouded in mystery for many centuries. Even the telescope which solved some of these mysteries has uncovered others so this planet continues to be a subject of curious interest from which many surprises are still expected. Mere mention of its name seems now to suggest some strange phenomenon.

The fourth planet in distance from the sun, and one of the five planets well known to the ancient people, Mars makes its revolution around the sun in 687 days, appearing in the sky, in "opposition" to the sun, as in Fig. 1, at intervals of slightly more than two years. The planet's diameter, at its equator, is given as 4215 miles, about half the diameter of the earth, and its period of rotation on its axis is 24 hours, 37 minutes and 22⅔ seconds, a value which has been determined from the records of 260 years' observations.

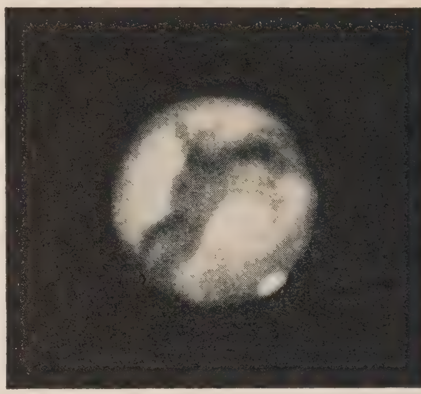

Fig. 1—The planet Mars, near opposition, showing the snow cap on one of the poles.

A Few Steps Backward

Probably the first feature about Mars which seemed mysterious was its apparently erratic movement amongst the stars. In the Second Book of the Kings (Ch. 23, v. 5) mention is made of "planets,"—the word meaning "wanderers,"—for it had been observed by that time that certain "stars" were in different positions in the sky each year and their wanderings were strange and unexplainable.

No doubt Mars drew most attention in this regard for upon each appearance of this planet it is seen to be moving eastward in relation to the stars but after a time it stops, seemingly travels westward for seventy days, Fig. 2, then stops again and begins travelling eastward as before. How strange for a heavenly body to turn backward in its course!

With the acceptance of the Copernican theory,—that the planets move around the sun,—and Kepler's laws governing planetary motion, this mystery was solved.

What actually happens is that the earth, travelling through space faster than Mars, overtakes that planet and for seventy days is passing it. Before and after this apparent reversal of motion, the earth is moving more directly towards or away from Mars so the latter's normal eastward motion is then apparent. It will be a very easy matter, without using any

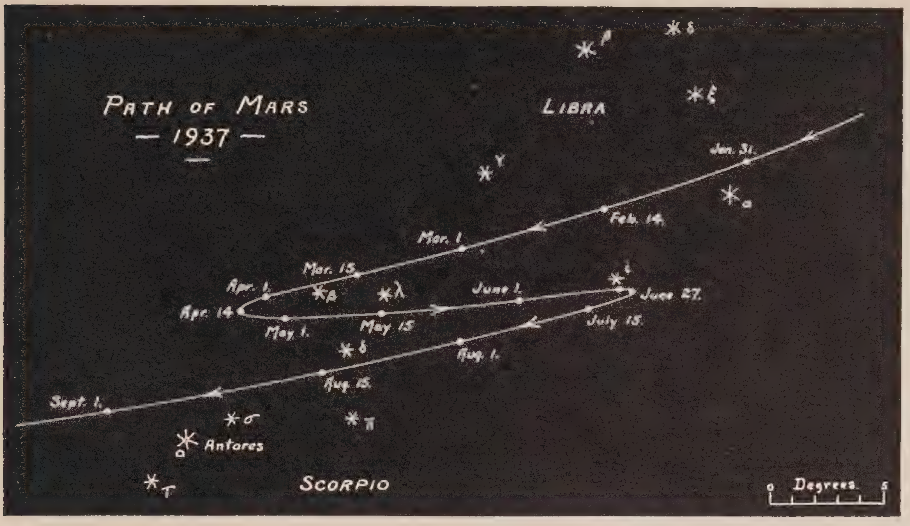

Fig. 2—The Path of Mars through the constellations Libra and Scorpio in 1937, showing apparent retrograde motion from April 14 to June 27th. Several of the brightest fixed stars in these constellations are shown for reference.

instrument whatsoever, to follow Mars in its course through the constellations Libra and Scorpio next Spring and to observe that the planet appears to travel westward from April 14th to June 27th. On August 23rd it will pass the bright red star, Antares, whose name means "the rival of Mars".

LIMITED PHASES

In 1610, Galileo, while exploring the heavens with his new telescope, observed that Mars changed its shape, sometimes being full, Fig. 1, and at other times being in the gibbous phases, but never appearing as a crescent. This, of course, had not been known before through lack of suitable instruments to reveal the phenomenon. With Galileo, however, it was but a short-lived mystery for he applied the information as proof that Mars' orbit was outside that of the earth, having a diameter about fifty percent greater than the earth's orbit.

Mars never presents to the earth less than five-sixths of its illuminated surface.

SATELLITES

"Gulliver's Travels," those well known stories of imaginary adventure written by Dean Swift of Dublin, were published in the year 1727. The author emphasizes the remarkable advancement of the astronomers of the fictitious "Flying or Floating Island of Laputa," in the following words,—

"They spend the greatest part of their lives in observing the celestial bodies. . . . They have made a catalogue of ten thousand fixed stars. . . . They have likewise discovered two lesser stars, or satellites, which revolve about Mars; whereof the innermost is distant from the centre of the

primary planet exactly three of the diameters, and the outermost, five; the former revolves in the space of ten hours, and the latter in twenty-one and a half; . . . evidently . . . governed by the same law of gravitation that influences the other heavenly bodies."

Here, truly, is a prediction which is positively uncanny for the satellites of Mars were not known until one hundred and fifty years after these stories were written. In 1877, Professsor Asaph Hall at Washington discovered two small moons, close to the planet, which have unusually short periods, practically as Dean Swift suggested, and up to the present time no more than two satellites have been found.

Phobos, the inner moon, revolves around Mars in 7 hours, 39 minutes,—i.e. less than one third of the Martian day. There is no other known satellite which revolves around its primary planet in less time than the latter rotates on its axis. This moon therefore *rises in the west* and *sets in the east,*—about three times a day. It is approximately ten miles in diameter.

Deimos, the outer moon, revolves around Mars in 30 hours, 18 minutes,—slightly longer than the period of rotation of the planet. It rises in the east and sets in the west, as does our moon, but remains in the sky continuously for *two days and two nights* between rising and setting. It is about 5 miles in diameter.

With so much mystery surrounding Mars, it seems quite in order that its satellites should have strange and unique behaviour, but one wonders how Dean Swift was able to predict them so accurately. Probably, knowing that the earth had one moon, and Jupiter four, and that Mars' orbit lies between the orbits of these planets, but nearer to that of the earth, he concluded that two satellites would be Mars' proper quota and that, since neither Galileo nor any of his successors had ever seen any such satellites, these must be small and close to the planet. In consequence of this latter condition, their periods would be very short. Whether or not the author reasoned in this way, however, we cannot know but in any case, "Lemuel Gulliver's" information was a very interesting prediction of remarkable accuracy which added further mystery to Mars.

LIFE ON MARS

That there is vegetation on Mars is not only very probable but is practically certain. The conditions on the planet, as now known, would permit plant life of certain types.

The gravitational attraction at the surface of the planet is about thirty-eight percent of that at the earth's surface so Mars can hold an atmosphere but it must be much thinner than ours, atmospheric pressure being about one-quarter of our own. Both oxygen and water vapour are evident, mists and clouds have been seen, and snow caps, which vary in size according to the seasons, appear at both of the planet's poles, Fig. 1.

The temperature range is from +60 to —40 deg. fahr.,—it freezes up every night. While plants which flourish in our tropical zone could not withstand the severe conditions on Mars, nevertheless there are plants growing in colder latitudes which probably could survive.

The inclination of the planet's axis is practically the same as that of the earth. As the north pole turns toward the sun, giving summer in northern latitudes, the snow cap recedes and the surface of Mars takes on a greenish colour. When summer is over and the snow cap starts to grow, this greenish shade is replaced by brown. There are some regions that are brown most of the time which suggests that these are deserts. These seasonal changes in colour of the planet's surface are very impressive and point most definitely to the existence of certain types of vegetation.

Is Mars Inhabited?

The great question concerning Mars, the mystery of most interest to dwellers on this earth,—Is Mars inhabited?—can as yet have only one answer;—"Perhaps."

In 1877, that same year in which Professor Hall discovered the two satellites, Giovanni Schiaparelli, Director of Milan Observatory, studied the surface of Mars and made a survey of it. He observed several dusky streaks crossing bright regions and these he named "canali,"—the Italian word for "channels." Through mistranslation, however, this has been interpreted as "canals."

Now while channels are natural passages, canals are *definitely artificial*. Mention of canals, therefore, immediately implied that construction projects of gigantic magnitude had been undertaken and at least partly completed, and consequently gave rise to the thought that Mars is inhabited by a race of intelligent beings. This thought has persisted up to the present day,—the mystery of life, or not.

A great deal of attention has been given to Mars by the Lowell Observatory in Arizona. The canali are found to be very straight and in some cases are double,—two parallel channels. They cross some of the so-called seas and form a network which may be for irrigation purposes. Professor Lowell claimed that he had found water flowing in these canali at the time that the pole cap was receding and that it flowed in such a manner as to suggest the use of large pumping equipment.

So there may be a race of human beings living on Mars. Their stature and proportions, however, would differ much from ours. As matter is not so heavy on that planet, the Martians could walk and jump much more easily than we but owing to the thinner atmosphere would need a much larger respiratory system. They are fancied too, as having very much larger heads. Altogether they would be quite different from those beings which we may call normal in stature.

That Message From Mars

That long-expected message from Mars,—it is not here yet, or, if it has come, we have not been able to receive it. It cannot be said that interplanetary communication is impossible but some factors are worth consideration.

Any message requires a sender, a medium and a receiver. The medium of space seems satisfactory for transmission of radio waves: the great distances between planets would require considerable power for transmission of signals but at suitable frequencies these requirements may be possible

to meet in the matter of equipment and directing of the waves.

A message, however, is a transmission of intelligence so both sender and receiver must be of corresponding development in this feature in order for the message to be understood. Perhaps this is the reason that we have no messages from the Martians. Did they pass our level of intellectual development many thousands of years ago so that they are now "talking over our heads," or are we so far advanced beyond them in our development that they cannot understand us? The lack of messages, then, may be due to the difference in ages of the races.

On the other hand, what would we have to talk about with them? Our conditions are different, our topics differ and there is no common language in which to discuss them. However, no one can say what the future will bring forth.

?

There would seem to be the rule that that which is only partially revealed arouses more interest and is enshrouded in more mystery than that which is completely hidden. So Mars, on whose surface some details are seen through the thin atmosphere, continues its course with a trail of mystery whereas Jupiter and Saturn, whose surfaces are completely hidden by clouds, are not subjects of so much speculation.

Some of Mars' mysteries have been solved, however, and new ones present themselves; but then, life would be most uninteresting if there were no more mysteries,—if everything were known.—*F. K. D.*

At the Touch of a Switch

By Editor, C. H. Hodge in "The Farmer Magazine"

PROBABLY every farmer and farmer's wife has dreamed of the time when at the touch of a switch, the house and stables could be lighted up and motors turned on to do the dozen and one chores that otherwise had to be done by hand at a heavy expenditure of time and labour.

Every young lad on the farm of 25 years ago had visions of a water system so arranged that he would no longer have to man the pump or lug pails of water to the stock; when a motor would be available to turn the grindstone, the cream separator and the fanning mill.

Thousands of farm men and women have lived to see that dream come true and thousands of young men now starting on farms of their own will find means of fulfilling yesterday's vision—tomorrow.

Electric power lines are extending this service to new farms, in Ontario, Quebec and the Maritimes as rapidly as good roads or the telephone were extended in pre-depression days.

1. Electrically equipped home of M. H. Haley & Son, Springford. 2. W. M. Bell, left and H. W. Sweazey, standing beside an emery wheel driven by the same electric motor that pumps the water for the house and barn and which is housed in the pump house shown in the rear. 3. The home of Howard Jull, R.R. 3, Norwich, one of the early users of Hydro, the pole at the right carries the transformer to step down the voltage from the high powered main line. 4. The old home of W. M. Bell, at Springford, built nearly 100 years ago. The new home on the highway is shown in 5. Both houses are equipped with Hydro. 6. The transformer and wiring that carries the power to the barn on the Bell farm. 7. Pump jack operated by an electric motor on the farm of Howard Jull. 8. The original 5 h.p. motor installed by Mr. Bell 20 years ago, is still in use driving the feed chopper as shown by this picture taken in Mr. Bell's granary during the visit to his farm.

What was once looked upon as just one more lúxury only city people could afford, is now rapidly becoming a valuable servant of the farmer and his family. Not to every farmer yet, it is true, but Ontario already has over 34,000 farms equipped with hydro, and at the rate farm power lines have been extended the past two years this number will soon be doubled if not trebled.

It is only a little over twenty years since power from Niagara Falls first lighted farm homes 100 miles away and turned the first motor to operate a corn cutting box.

One of the first lines established was the rural power line from Nor-

wich to Newark in Oxford county. Recently with J. W. Purcell, of the Ontario Hydro Commission, the editor of "The Farmer Magazine" visited some of the farmers whose twenty-year contracts for this early installation have expired.

Mr. Purcell was one of the engineers who helped to secure these first contracts, supervised the building of the line and the equipment of the farms. He recalled some of the difficulties in getting power out to these farms in those days and the skepticism that prevailed in certain quarters about the possibility of farmers using electricity.

This first farm line out of Norwich started as the result of a break down of an engine on a silo-filling outfit. Mr. Purcell and his men ran a line of soft fence wire out to the farms, strung on insulators on the telephone poles, installed an electric motor and enabled the farmers to finish filling their silos and do their threshing.

This was in 1913 and some of those old motors are still in use.

Sceptics are to be found in every community and when a mill in Norwich burned down that had been using a load of 75 horsepower, doubt was expressed as to the ability of the town to carry the cost of their hydro line with this big consumer removed. It required a lot of argument to sell the idea to the local leaders in the community that the farm homes around would use twice this amount if it could be taken to them.

Mr. Purcell reported that $6,000 worth of debentures were sold in six hours in the local community to finance local village lines and today these rural homes have added four times the load lost through the burning of the mill.

Equally significant of the desire of the farmer and his family to secure the benefits of electricity was the statement of W. M. Bell, of Springford, one of the farmers instrumental in securing this first line out of Norwich. He recalled that in two days spent with the local hydro superintendent at Norwich, in visiting farmers along the proposed line, they secured 34 contracts covering the twenty-year period that was necessary in those days in order that a line might be built and its cost financed over a period of years.

Equipping a farm home electrically in those early years was far more of an undertaking than it is today. To begin with they had to sign contracts for twenty years—a long period to agree to accept, use and pay for a utility they had done without for years. It also cost considerably more for current than it does today. The accompanying table showing actual bills for current paid by farmers at that time compared with what they pay today, illustrates this clearly. The farmer can use nearly four times the current today at half the cost of even 15 years ago.

"But are farm homes on rural power lines being equipped with modern electrical conveniences to the same extent as the average urban home?" I asked H. W. Sweazey, Superintendent of the Norwich Rural Power District. His reply was to hand me the following list of electrical appliances installed in the houses and barns of his consumers:

Appliances in the Barn

Electric	motors	139
"	pumps	33
"	grain grinders	22
"	milkers	23
"	milk cooler	1
"	cream separators	27
"	churns	4
"	incubators	3

Appliances in the Home

Electric	ranges	68
"	hot plates	145
"	washers	306
"	cleaners	23
"	water heaters	18
"	grates	3
"	port. air heaters	33
"	refrigerators	13
"	hand irons	392
"	ironers	3
"	toasters	251
"	radios	342
"	furnace blowers	3
"	sanitary systems	81

To compare the amount of electric power used in the Norwich district by typical farm consumers for the past year with that used for a similar period in 1925-26, Mr. Sweazey gave me the following statements taken from their records.

Farmer A., operating a washing machine, radio, iron and air heater in the house and a five horsepower chopper and two horsepower pump in the barn, with lights for both buildings, used the following amount of power for these two respective periods:

Total Kilowatt Hrs. Consumed:	
1925-26 (10 Mos.)	902
At First Rate of 5c	613
At Second Rate of 2c	289
Service Charge	$41.56
Net Bills	$70.19

Total Kilowatt Hrs. Consumed:	
1935-36 (10 Mos.)	1570
At First Rate of 3.5c	840
At Second Rate of 2c	730
Service Charge	$30.51
Net Bills	$67.07

Farmer B., operating an electric range, toaster, washing machine, iron, radio and sanitary system in the house and a five horsepower motor and water pump in the barn, with lights in each case, used:

Total Kilowatt Hrs. Consumed:	
1925-26 (13 Mos.)	3665
At First Rate of 5c	840
At Second Rate of 2c	2825
Service Charge	$51.60
Net Bills	$135.09
Total Kilowatt Hrs. Consumed:	
1935-36 (13 Mos.)	3620
At First Rate of 3.5c	840
At Second Rate of 2c	*2450
Service Charge	$30.51
Net Bills	$100.26

*An additional 330 kw.hr. were used at the third rate of ¾c.

Two similar farms from the Woodstock Rural Power District, as given by H. R. Viger, Superintendent for the district, give an even more striking comparison.

Farmer C., now operates a vacuum cleaner, a four-burner range, toaster, iron, water heater, sanitary water system, washing machine, radio and electric fireplace in the home; two motors—one and one-half horsepower and one-half horsepower, a water system and cream separator in the barn, and lights for both. In 1923, he had only the vacuum cleaner, toaster,

washing machine, iron and pressure water system in the house and a five horsepower grinder, two horsepower pump and milking machine in the barn, with lights of course.

Total Kilowatt Hrs. Consumed:	
1925-26 (11 Mos.)	2460
First Rate at 5c	770
Second Rate at 2c	1690
Service Charge	$86.02
Net Bills	$145.95

Total Kilowatt Hrs. Consumed:	
1935-36 (12 Mos.)	12920
First Rate at 3c	504
Second Rate at 2c	2736
Third Rate ¾c	9680
Service Charge	$28.32
Net Bills	$176.57

Farmer D. now operates a four-burner range, toaster, iron, water-heater, sanitary system, washing machine, radio, air heater and warming pad, in the house; a one horsepower utility motor, one and one-half horsepower grain grinder, milking machine, pressure water system, motor driven emery wheel in the barn, compared with only an iron, washing machine and vacuum cleaner in the house and a five horsepower grain grinder and water system in the barn in 1923. His power consumption for the two periods was:

Total Kilowatt Hrs. Consumed:	
1923 (11 Mos.)	2830
First Rate at 5c	770
Second Rate at 2c	2060
Service Charge	$86.02
Net Bills	$152.60

Total Kilowatt Hrs. Consumed:	
1935-36 (10 Mos.)	7320
First Rate at 3c	504
Second Rate at 2c	2736
Third Rate ¾c	4080
Service Charge	$28.32
Net Bills	$138.70

In these examples it is very noticeable that there has been a decided increase in the number of appliances used and in the amount of current consumed, yet the total bills for power have increased little if any, and in some cases have actually decreased. The explanation lies largely in the decrease in service charges, the lowering of the contract class and the fact that most of the increase has been in the "third rate" column, which costs only three-quarters of a cent per kilowatt-hour compared with three cents per kilowatt-hour for that charged at the first rate.

Thus the farmer can and is utilizing far more electrical conveniences in his home and in his barns than he could in the earlier days without any increased cost for power. Apparently all that is necessary to secure this power at the low third rate is that he limit his electric motor uses to what can be handled by a two-horsepower motor so that he can qualify for a class three installation, as it is termed by the hydro, instead of attempting to use a larger motor, requiring a more expensive system of installation and a much larger volume of power used at the first and second rates before the third rate comes into effect.

It will be noted that in the two Woodstock illustrations cited, both farmers have changed from the original five horsepower motors they had in 1923 to the one and one-half and one-half horsepower motors that enabled them to qualify for a class three contract.

Association of Municipal Electrical Utilities

Convention Programme

THE programme of the winter convention of the Association of Municipal Electrical Utilities, which will be held at the Royal York Hotel, Toronto, on Tuesday and Wednesday, February 2nd and 3rd, 1937, is now practically completed. This convention will be held concurrently with the annual meeting of the Ontario Municipal Electric Association and the two Associations will meet in joint session on the morning of Wednesday, February 3rd, 1937. The proceedings of the Association of Municipal Electrical Utilities convention will be after the following order:—

TUESDAY, February 2nd, 1937

MORNING:

Registration.
10.30 o'clock.
Convention Session.
Reports of Committees.

AFTERNOON:

12.30 o'clock.
Convention Luncheon with O.M.E.A.
Address.
2.30 o'clock.
Convention Session.
Election of Officers for 1937.

The Ballot will be closed immediately after the opening of this session and the results will be announced before it closes.

Paper—"House Wiring", by Paul Warner, Consulting Engineer, Mellon Institute, Pittsburg, Pa. Guest of Canadian Westinghouse Company.

Paper—"The Utilities' Interest in Shunt Capacitors", by Hugh Rose, Specialist Engineer, Canadian General Electric Company, Toronto.

Paper—"Ground Line Preservation of Wood Poles", by William Volkman, Vice-Chairman, Research Sub-Committee on Treatment of Wooden Structures, Hydro-Electric Power Commission of Ontario, Toronto.

EVENING:

6.30 o'clock.
Convention Dinner with O.M.E.A.
Entertainment—Address.

WEDNESDAY, February 3rd, 1937

MORNING:

9.30 o'clock.
Convention Session. Joint Session with O.M.E.A.

Paper—"Promoting our Business" by M. E. Skinner, Vice-President, Buffalo, Niagara and Eastern Power Corporation, Buffalo, N.Y.

Paper—"The Relation of the Commissioners to the Management", by G. S. Matthews, Chairman Public Utilities Commission, Peterborough.

Paper—"An Opportunity for Executives" by Wills Maclachlan, Secretary-Treasurer and Engineer, Electrical Employers Association of Ontario, Toronto.

AFTERNOON:

12.30 o'clock.
Convention Luncheon with O.M.E.A. and The Electric Club of Toronto.

Address—"Let's See", by Dr. M. Luckiesh, D.Sc., D.E., Director of Lighting Research Laboratories, General Electric Company, Nela Park, Cleveland, Ohio.

2.30 o'clock.

Convention Session.

Paper—"Hydro Water Heaters for Commercial Consumers", by J. F. Thomlinson, Power Engineer, Toronto Hydro-Electric System.

Paper—"Pipe Thawing", by R. L. Dobbin, General Manager, Public Utilities Commission, Peterborough.

* * * *

Election Ballot

The ballots for the election of officers for the Association of Municipal Electrical Utilities for the year 1937 will show the following as candidates:

PRESIDENT—H. F. Shearer, Welland (Acclamation).

VICE-PRESIDENT—H. R. Hatcher, Galt; R. S. Reynolds, Chatham.

SECRETARY — S. R. A. Clement, H.E.P.C. of Ontario (Acclamation).

TREASURER—B. Faichney, H.E.P.C. of Ontario, Toronto; W. B. Munro, H.E.P.C. of Ontario, Toronto.

DIRECTORS (From the Membership at Large)—C. E. Brown, Meaford; G. E. Chase, Bowmanville; T. R. C. Flint, Toronto; A. B. Manson, Stratford; O. H. Scott, Belleville; P. B. Yates, St. Catharines.

DISTRICT DIRECTORS

NIAGARA DISTRICT—R. Harrison, Scarborough Township; V. A. McKillop, London.

GEORGIAN BAY DISTRICT—H. S. N. Denef, Hanover; J. R. McLinden, Owen Sound.

CENTRAL DISTRICT — G. F. Shreve, Oshawa; F. A. Sprentall, Stirling.

EASTERN DISTRICT—M. W. Rogers, Carleton Place; R. J. Smith, Perth.

NORTHERN DISTRICT—C. J. Moors, Fort William (Acclamation).

The election ballots will be distributed during the morning of the first day of the convention, February 2, 1937, and until the opening of the afternoon session on that day. Immediately after the afternoon session is opened the ballot will be closed and the results of the elections will be announced before that session is adjourned.

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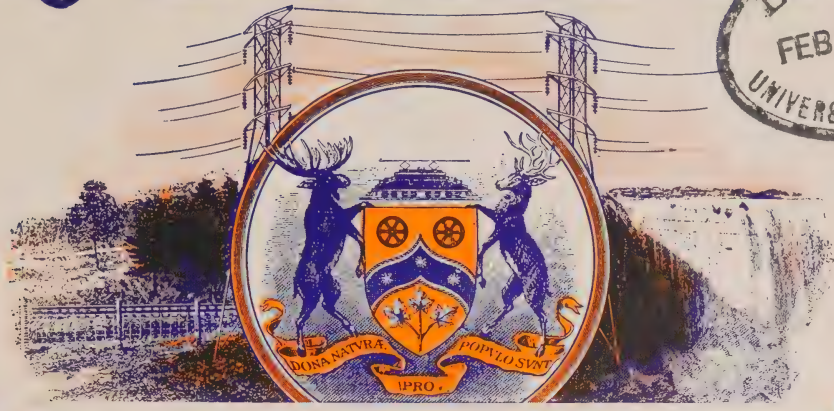

POWER FOR MUNICIPAL UTILITIES

POWER FOR HOUSEHOLD CONVENIENCES

Hydro-Electric Power Commission of Ontario

Volume XXIV JANUARY, 1937 Number 1

POWER FOR INDUSTRY

Silver Falls, Kaministiquia River

LIGHT FOR THE HOME

HYDRO IS YOURS - *USE IT* !

Municipal Loads and Interim Bills

December, 1936

NIAGARA SYSTEM

Municipality	H.P.	Dollars
Acton	970	2 385
Agincourt	163	511
Ailsa Craig	99	400
Alvinston	84	505
Amherstburg	779	2,304
Ancaster Twp.	297	729
Arkona	53	306
Aurora	1,107	2,353
Aylmer	555	1,502
Ayr	196	513
Baden	352	896
Beachville	401	1,019
Belle River	138	431
Blenheim	429	1,305
Blyth	101	432
Bolton	144	485
Bothwell	119	442
Brampton	2,481	5,997
Brantford	15,173	31,021
Brantford Twp.	679	1,670
Bridgeport	111	310
Brigden	69	357
Bronte	147	388
Brussels	139	552
Burford	154	418
Burgessville	31	135
Caledonia	315	775
Campbellville	34	165
Cayuga	115	435
Chatham	5,745	13,644
Chippawa	275	538
Clifford	69	309
Clinton	428	1,266
Comber	130	471
Cottam	69	243
Courtright	38	214
Dashwood	87	346
Delaware	48	156
Dorchester	91	301
Drayton	100	448
Dresden	317	1,098
Drumbo	59	189
Dublin	36	173
Dundas	1,798	3,670
Dunnville	1,110	2,728
Dutton	248	734
Elmira	618	1,726
Elora	316	882
Embro	94	348
Erieau	66	282
Erie Beach	7	39
Essex	433	1,209
Etobicoke Twp.	4,963	10,546
Exeter	413	1,256
Fergus	980	2,736
Fonthill	124	325
Forest	350	1,270
Galt	6,778	13,839
Georgetown	1,246	3,477
Glencoe	202	903
Goderich	1,075	3,629
Granton	96	292
Guelph	9,366	19,902
Hagersville	397	1,010
Hamilton	100,714	184,642
Harriston	300	1,012
Harrow	355	1,080
Hensall	165	654
Hespeler	1,884	4,160
Highgate	74	273
Humberstone	426	940
Ingersoll	2,281	5,038
Jarvis	193	603
Kingsville	538	1,637
Kitchener	17,987	36,724
Lambeth	123	406
La Salle	186	536
Leamington	1,355	4,009
Listowel	969	2,786
London	34,951	71,358
London Twp.	513	1,346
Long Branch	852	1,952
Lucan	136	402
Lynden	87	258
Markham	306	881
Merlin	71	257
Merritton	5,043	9,036
Milton	653	1,768
Milverton	284	793
Mimico	2,433	4,765
Mitchell	466	1,224
Moorefield	72	227
Mount Brydges	87	288
Newbury	46	198
New Hamburg	405	1,096
Newmarket	1,560	3,316
New Toronto	6,391	14,647
Niagara Falls	9,735	15,413
Niagara-on-the-Lake	403	823
Norwich	373	1,011
Oakville	1,167	3,096
Oil Springs	203	703
Otterville	94	332
Palmerston	413	1,289
Paris	1,299	2,761
Parkhill	155	745
Petrolia	1,017	3,230
Plattsville	59	233
Point Edward	1,109	3,280
Port Colborne	1,789	3,952
Port Credit	752	1,974
Port Dalhousie	510	1,168
Port Dover	369	1,092
Port Rowan	68	300
Port Stanley	201	612
Preston	2,819	5,755
Princeton	117	413
Queenston	95	210
Richmond Hill	402	1,089
Ridgetown	526	1,556
Riverside	1,016	2,668
Rockwood	114	355
Rodney	155	606
St. Catharines	11,517	19,676
St. Clair Beach	48	151
St. George	162	507
St. Jacobs	260	682
St. Marys	1,164	3,249
St. Thomas	7,163	15,222
Sarnia	8,302	21,102
Scarborough Twp.	3,457	8,498
Seaforth	490	1,326
Simcoe	2,127	4,875
Smithville	231	489
Springfield	66	250
Stamford Twp.	2,131	3,729

THE
BULLETIN

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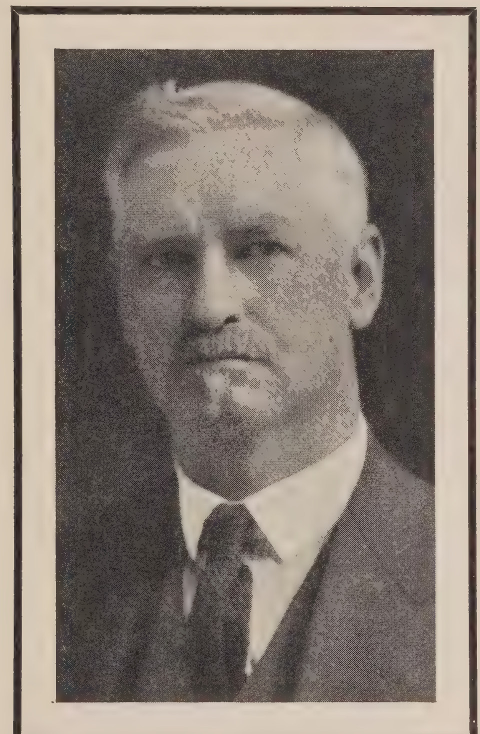

John W. Purcell

IT is our sorrowful duty to record the passing of a very popular and highly respected member of the Hydro staff in the person of John Wilbert Purcell, on the morning of Wednesday, January 6, 1937.

On Saturday, December 12, 1936, he was at the office and appeared in his usual health, but during that evening while on a visit to his niece, Mrs. Oliver Spanner, he was seized with a heart attack. Following this pneu-

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Vol. XXIV No. 1

January, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

monia developed, but as time went on he began to show improvement, which up to the day before his death had advanced to a point where he was permitted to leave his bed for short periods. Early the next morning, however, he took a bad turn and soon passed away.

Mr. Purcell was born at Listowel, Ontario, in 1872. Leaving school in 1890 he entered the electrical industry and worked in various electrical manufacturing plants until about 1893. He then became Superintendent and Chief Inspector of the Detroit Electric Light and Power Company, where he remained until 1896, when the Company was sold. After this he entered the employ of Hiram Walker and Sons, Walkerville, Ontario, as Superintendent of the Light and Power Department. Here he remained until February, 1912, when he came to the Hydro-Electric Power Commission of Ontario as Assistant Engineer in the Municipal Engineering Department.

His duties with the Commission have been those of assisting in developing loads in urban municipalities and rural districts. More particularly did he devote his time to the development of applications of electricity to farm uses, in which work he was a pioneer. In addition to working out electric motor applications to existing farm equipment, he was instrumental in the development of improved and more economical methods of performing operations either by changing the design of equipment or by applying electricity to new purposes. Two outstanding examples are the development of grain choppers using small motors and especially designed cutters, and the applications of electric power to plant growth, seed propagation and soil heating.

The nature of Mr. Purcell's work brought him into contact with a great number of people throughout the Province, and his happy faculty of being able to enter into the interests of those whom he met resulted in his having a very wide circle of friends.

Prior to coming to the Hydro Commission, Mr. Purcell was an active member of the Canadian Electrical Association. He was an Associate Member of the American Institute of Electrical Engineers and a Member of

the Association of Professional Engineers of Ontario.

His wife predeceased him last Spring. They had no surviving family. He leaves one sister, Miss Nina Purcell of Stratford.

E. B. Merrill

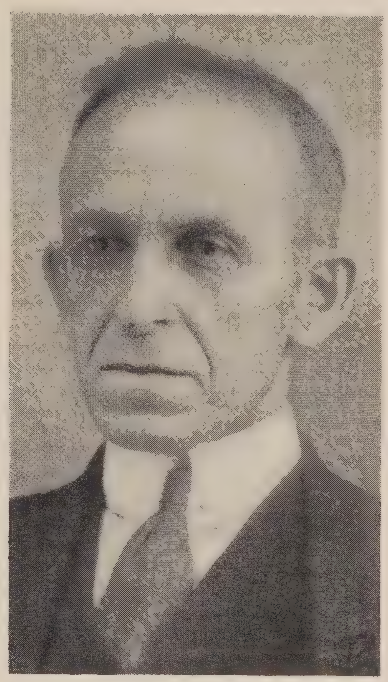
Edward Belden Merrill, son of the late Judge Edwards Merrill of Picton, Prince Edward County, Ontario, died at his mother's home, 4 Prince Arthur Ave., Toronto, on Saturday, January 9th, of pneumonia.

He was educated at Picton Public, and High Schools, and at the University of Toronto where he received the degrees of B.A., and B.A.Sc., and a Fellowship in Mechanical and Electrical Engineering.

Mr. Merrill was the second principal in the Toronto Technical School, and subsequently entered the employ of the Westinghouse Electric and Manufacturing Company of Pittsburg, Penn. Later he went to England and was associated with Siemens Bros. & Co. of London. After a time he returned to Canada to join the Toronto & Niagara Power Co., and following this he went West to the City of Winnipeg Electrical Development Co.

In 1914 Mr. Merrill joined the staff of the Hydro-Electric Power Commission of Ontario, from which he only lately retired.

The subject of this sketch was very much of an outdoor man, his recreations including sailing, canoeing, swimming, skating, squash and tennis, in all of which he excelled. There was always a sailing yacht available



Edward Belden Merrill

at his father's home in Picton, and one summer when on a holiday there, he made a trip around Prince Edward County with his father (also an ardent sailor) and Dr. Morely Currie, M.P., an interesting account of which, in diary form, was later published in a pamphlet.

He was an enthusiastic amateur artist, and paintings of his have been on view annually at Hart House, University of Toronto.

Mr. Merrill was deeply interested in Calendar Reform, for many years, and an important article embodying his plan for a revised calendar appeared in a recent issue of The Forum, following which he received letters from

prominent scientists in various parts of the world who were interested in his ideas.

He was also much interested in town-planning, in connection with which he evolved a Scheme for improving downtown Toronto, which was favourably commented on by the press at the time.

Surviving are his widow, a daughter of the late Bishop Reeve, and one daughter, June; his mother, Mrs. Edwards Merrill, and two sisters, Miss Anne Merrill, and Mrs. Frank Egerton, all of Toronto.

Interment took place in the family plot in Glenwood Cemetery in Picton, on January 11th.

Hydro at the End of 1936

By T. Stewart Lyon, Chairman, Hydro-Electric Power Commission of Ontario

THE outstanding features of the operations of the Hydro-Electric Power Commission of Ontario during the past year have been a steady, if still not very rapid, growth in the demand for power in industrial centres and the very remarkable increase in the use of electric energy in the gold mining and milling industry in Northern and Northwestern Ontario.

A statement of earnings and cost of power in the years 1929 to the end of the Commission's fiscal year, Oct. 31, 1936, gives some indication alike of the depth of the depression and of the extent of the recovery from it.

The Commission's revenue, in the Niagara System, was in the year ending October 31:—

1929	$21,624,000
1930	24,467,000
(A total not exceeded since that time).	
1931	23,752,000
1932	22,229,000
1933	$21,385,000
(Low water mark).	
1934	22,706,000
1935	23,364,000
1936	24,341,000

We have, therefore, arrived at a point only $126,000 short of the peak earnings of 1930, and there is reasonable expectation that the earnings shown in 1937, despite a reduction of almost $2,000,000 in the amount to be charged for power during 1936-1937 to the Cost Municipalities of the Niagara System, will be fully equal to those of the Commission's year that has just closed.

Niagara System Loads

The volume of power supplied to the municipalities of the Niagara System during the past year and to the rural districts and private consumers having direct relations with the Commission has been slightly higher than that of the peak year, which was:

1929	931,261 h.p.
1930	875,518 h.p.

1931	805,630 h.p.
1932	839,946 h.p.
1933	848,793 h.p.
1934	856,434 h.p.
1935	875,067 h.p.
1936	935,254 h.p.

These figures are for October, the closing month of the Commission's fiscal year, in each case. The December figures, which have been partly estimated for this year, indicate a primary peak for the present year, November 1, 1936, to October 31, 1937, of 1,015,000 h.p , or 1,020,000 h.p. this month, as compared with 969,123 h.p. in December, 1929.

On the most favorable construction of the figures, the actual increase in the use of primary power in the Niagara System during the past eight years has been 46,000 h.p., plus whatever amount may be reasonably added because of the fact that distribution is now to a much greater degree than formerly, under the Quebec contracts, from Niagara Falls rather than from the Ottawa river. By the distribution of a larger part of the load from Niagara and a smaller part from the Ottawa transmission, losses have been lessened, it is believed, to the extent of 25,000 h.p.

It may be pointed out, without trenching on controversial matters, that this increase of 46,000 horsepower in December, 1936, as compared with December, 1929, is not quite ten per cent. of the total amount added to the supply of power under the contracts with Beauharnois, Ottawa Valley and Maclaren-Quebec, all of which were signed in 1929 and 1930. These contracts called for a payment by the Commission, as of November 1, 1936, for a total amount of 471,000 horsepower. They, therefore, increased the obligations of the Commission to pay for power to an extent ninety per cent. greater than the amount the Commission has obtained from the use of such part of the power as could be profitably marketed. As from November 1, 1936, under all the former Quebec-Niagara contracts, the Commission's obligation was to pay $10,965,000 a year for 731,000 horsepower. Actually during the year, 1936-1937, the Commission will be able to find profitable use for only 180,000 horsepower.

The question of importance, especially to the manufacturers of the Niagara System, is that of the adequacy of future supplies. It is not necessary that I should go into details in this brief review concerning the manner in which the Commission proposes to maintain sufficient supplies for future needs of the Niagara System. Briefly, it may be said that there is still a reservoir cf 120,000 h.p. of immediate stand-by and general reserve power, provided for in the revised Gatineau contract, upon which the Commission can draw at any time should the need arise. The Commission will gladly welcome any new industrial firm power contracts that may offer, or enlargements of business under present contracts, in the confident belief that the existing general reserve of power and the possibility of adding to this power reserve from sources within the Commission's control, will provide a safe margin of power beyond the requirements of industry for a number of years.

Northern Demand Grows

Progress in the North, where electric energy is supplied to mines, paper mills, smelters and domestic consumers by power developments and by transmission systems owned by the people of Ontario, and operated by the Hydro-Electric Power Commission, under authority of the Government, as the people's trustee, has been very marked during the past twelve months. Generating capacity at the Ear Falls plant has been doubled, and a large increase will shortly be brought into use at the Rat Rapids development. Construction of a line from the Nipigon River plants of the Thunder Bay System into the Little Long Lac district will proceed throughout the winter, and ample supplies of power will be avaliable early in the summer for the exploitation of the spectacular discoveries in the Little Long Lac gold field.

There has been a very remarkable growth in the use of power from Abitibi Canyon development, which is now supplying, under firm contracts, 65,000 h.p. for mining and metallurgical operations. The reduction in the cost of power in the mining districts, because of the entry of the Commission into the field, has assisted greatly in the development of properties containing large quantities of "marginal" ore. Much of this ore was of a grade too low to be mined and milled profitably when gold was worth $20.00 an ounce and power cost the operator $50.00 per h.p. per year for long-term contracts. Gold at almost $35.00 and power at from $32.50 to $35.00 per h.p. per year has changed the picture to an extraordinary extent. Thousands of men are employed now in preparing properties for production on a great scale that could not have been operated at the former price of gold and of power. We look for an extension of this development that will enable us to utilize to the profit of the people of Ontario practically all the available power provided by the Canyon development.

A considerable proportion of the output from this source of power supply is now being utilized under electric steam boilers, to provide steam for important paper mills in the North, which, if this surplus power were not available, would have to spend great sums for coal and its transportation.

Eastern Ontario System

In Eastern Ontario System increases in the use of power, while not so phenomenal as in the North, are steady and persistent. It has not been found profitable to use the entire 60,000 h.p. of 60-cycle energy available for Eastern Ontario under the revised Gatineau contract, but the steady increase in the demand for power in the Eastern System may call before long for the development of one of the power sites on the Madawaska River, acquired seven years ago, and the addition of this power to the distributing stations of the Trent Valley and cities such as Oshawa, which are increasing their demands for energy because of the enlargement of manufacturing plants.

An agreement has been arrived at between the Dominion Government, the Government of Ontario, and the Hydro-Electric Power Commission,

under which available water at the various dams of the Trent Canal will be utilized more systematically in the power plants of the Commission for the production of energy, when and where needed, instead of being held chiefly, as they have been heretofore, to facilitate non-existent navigation. Co-operative regulation of the flow of the rivers of the Trent System will provide considerably more power than is now obtained from the Trent Valley, and at times when it is most needed by manufacturers and municipal distributing plants.

There are potentialities in the Madawaska System, the improved Trent development, and the balance of the Gatineau contract for the supply, at any time it may be required, of a greater quantity of power than is now being used throughout the entire Eastern Ontario System, so that from Whitby to the boundaries of Quebec, as in the Niagara System, the Commission would welcome any additions that may be offered to the existing light and power loads.

Rural

The development of the Rural Power Department of the Commission's business proceeds at an accelerated rate. The thickening of traffic on existing rural lines will be facilitated by the recently adopted reduction of the service charge for farm consumers, from $2 to $1 per month net. There are many thousands of farm homes, passed by rural transmission lines, which do not use the energy at their doors. The reduction of the service charge will, it is hoped, induce many of such farm homes to become consumers to their own profit and to that of their neighbors who already use electrical energy in their homes and their farm operations. Every additional consumer per mile of line reduces to a marked degree the cost of energy to all others upon that line.

May I, in closing this brief summary of the operations of the Hydro-Electric Power Commission during the past year, thank our more than half-a-million consumers for the increased business they have enabled the Commission to do during the year that is past, and express the hope that year by year in the future a greater variety of profitable uses will be found for electric energy in the homes, the stores, the warehouses, the factories, mills and mines of the Province.

Hydro-Electric Practice in Canada

T. H. Hogg, D. Eng., M.E.I.C., Chief Hydraulic Engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ontario

(Presented before the Niagara Falls Meeting of the American Society of Mechanical Engineers, on September 17th to 19th, 1936)

THE writer of a paper presented at the World Power Conference at London in 1924, dealing with water power development in Canada, made this assertion:

> "It may be stated, with a fair degree of assurance, that the future holds no prospect of revolutionary advances in the art such as have taken place in the last twenty years."

That period had seen a gradual increase in unit capacity of turbines, an improvement in their efficiency, an extension in realization of high efficiency over a greater percentage of the full capacity of the unit, perfection of the means of supporting revolving weights, and development of effective means of controlling long water columns.

Reference was made to the position at that time of the propeller type runner, undoubtedly, a revolutionary advance in water-power development, which was, in 1924, just beginning to find its place. European and American practice had diverged somewhat in the development and application of this type of equipment, and to this reference is made later.

A field inviting investigation at that time was the cause and nature of pitting of turbine runners. The extent to which this proceeded in comparatively brief periods in many installations and the perfect freedom from it in others presented problems of great scientific and economic interest. Decided advances have been made toward a solution of the problems presented by the phenomena of pitting.

Reviewing changes that have taken place since 1924, we find improvements have been made in governing equipment, in draft tube design and in simplification of the layout of the hydraulic plant, but, in general, it may be said that the prediction of the improbability of revolutionary advances in the art, as far as hydraulic plant is concerned, has been confirmed.

This is not so, however, in the broader field of hydro-electric practice. In generation, transformation and transmission of electric power, notable changes have taken place. It is significant, however, that these changes do not apply so strikingly to generating and transforming equipment as to switching, control and protective equipment. True, there has been advance in generator design and changes in practice regarding transformer equipment, but these are comparable to the advances made in the turbine, draft tube and plant layout.

STATISTICAL

In common with many other countries, Canada has experienced a rapid growth in water-power development. Developed water power, which at the beginning of the century aggregated less than a quarter of a million horsepower, through a fairly rapid growth reached a total of 3,590,000 h.p. by 1924. The rate of growth thereafter for eight years was at the extremely rapid rate of 440,000 h.p. per year, so that the total developed power exceeded 6,125,000 h.p. at the end of 1930. It was hardly to be expected that the rapid growth which took place under the impetus of the business expansion subsequent to 1924 would continue until the present, but, in spite of the adverse economic conditions of recent years, there has been a great increase in developed power, until at the end of 1935 it amounted to 7,909,000 h.p.

It is quite true that a portion of the increase since 1930 is accounted for by the completion of developments planned in the years preceding 1930. In view of this, a more significant gauge of the growth of the industry is provided by the number of kilowatts generated by central electric stations. It must be kept in mind that central electric stations include only those electric stations which generate power for distribution, and therefore do not include hydraulic and hydro-electric stations generating power for specific industrial establishments. As ninety-eight per cent. of the output of central electric stations in Canada is generated in hydro-electric plants, and as the great majority of hydraulic plants are included in

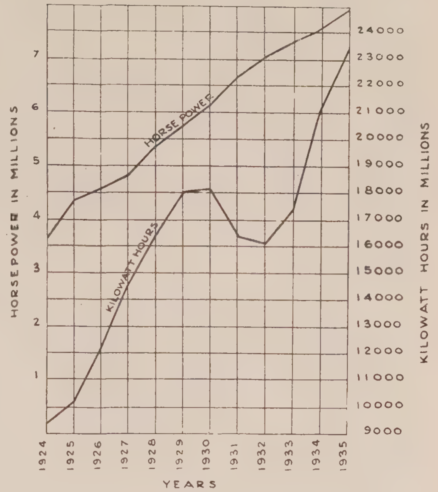


Fig. 1—Installed Hydraulic Horsepower and Energy Generated in Central Electric Stations 1924-1935.

central stations, the energy generated in central stations year by year is a very reasonable gauge of the growth in importance of the hydro-electric industry. The output of central electric stations in Canada amounted to 9,315,277,000 kilowatt hours in 1924, and to 18,093,802,000 in 1929, after which a decline took place until 1932, when the output amounted to 16,052,057,000; but a subsequent steady increase carried it to 23,410,000,000 kilowatt hours in 1935. Developed hydraulic horsepower and output of central electric stations year by year since 1924 are shown in Fig. 1.

POWER SUPPLY FOR MINING INDUSTRIES

An outstanding feature in the use of hydro-electric power is the growth in amount and special provisions for meeting the requirements of mining and related industries. To appreciate the significance of this, it is necessary

to consider recent developments in mining in the Dominion.

The remarkable growth of the industry is shown by a consideration of the value of mineral production, which fifty years ago had a value of only $10,200,000.00, but has grown in recent years as indicated in the table following:

1896	$ 22,474,256.00
1906	79,286,697.00
1916	177,201,534.00
1926	240,437,123.00
1935	310,162,455.00

The value of production was as high in 1929 as in 1935, after which there was a slight decline, from which the industry has now recovered. In considering these figures it must be kept in mind that, while gold has risen in price, nickel has remained stationary, and all other products, metallic and non-metallic, bring lower prices than when the record of 1929 was made. Copper, lead and zinc are now selling at very low prices, lead and zinc remaining close to their minimum value. The present high production thus indicates a greatly increased gross tonnage from the mines, a greater use of power, and wider employment of machinery.

To meet the power requirements of the industry, numerous isolated developments have been necessitated by mines located far from existing sources of power supply and at points to which transportation of equipment is difficult and costly. This latter feature is not new in the mining industry, but in Ontario and Quebec, lacking as they do coal deposits, it precludes the use of fuel-produced power for mining and milling operations. Diesel power is utilized in some places in these provinces, and for preliminary operations in a new field local fuel is used, but one of the earliest concerns of the mine manager now is to locate a dependable source of electric power. Probably ninety per cent. of the mines in Ontario and Quebec use electric power for all purposes. Furthermore, electric equipment is used more extensively for domestic purposes in the communities in the mining districts than in other parts of these provinces.

Hydraulic Turbines

The prediction referred to above that we had, in 1924, probably reached the ultimate in efficiency of Francis type turbine runners has been confirmed. No claims have been made for greater efficiency than was obtained at that time in a number of notable developments in Canada and elsewhere. In March 1925, extensive and careful tests were made on unit No. 7 at the Queenston development at Niagara Falls. This unit has a rated capacity of 58,000 h.p. under a head of 294 feet, and a specific speed of 38. The turbine efficiency realized is believed to be as high as, or higher than, has been obtained in any other installation, and, what is more important from an operating standpoint, unusually high efficiency was realized over a very great range of output. The maximum turbine efficiency was 93.8 per cent., and the efficiency was greater than 90 per cent. for a 48 per cent. of the range in capacity of the turbine.

The Abitibi Canyon development is fairly comparable with the Queenston development and, as far as the layout

and size of the units are concerned, is quite similar to it. The turbines are rated at 66,000 h.p. under a head of 237 feet, and have a specific speed of 41.5. Tests were made on four of the units at this development in January, 1936, by the same method as was used at Queenston. The maximum turbine efficiency realized was 93.6 per cent., nearly the same as at Queenston, and the range of high efficiency was also practically the same.

Thus, over a period of eleven years no improvement is observed in the efficiency results for large Francis type runners of moderate specific speed, mainly because the ultimate has been so closely approximated at the beginning of that period. To-day's turbine, however, is in many respects a better machine, due to improvements in mechanical design and manufacturing methods. One illustration of this may be cited. In two installations of large size in which turbine gate leakage was measured, this amounted to less than three-tenths per cent. of full gate discharge in the one case, and less than one-tenth per cent. in the other case. Formerly, a turbine gate leakage of one per cent. was not considered excessive.

Turbine practice has advanced, however, in the use of high specific speed runners, particularly in the extension of the application of these to higher powers and to higher heads than was the case ten years ago. Reference has been made from time to time in technical publications to the difference in European and American practice in the use of the high speed runner. In Europe, few installations use the fixed blade propeller type runner, the field being practically monopolized by the Kaplan runner. In the United States, while the fixed blade runner is used more frequently, there are also many Kaplan runners in service, some of very large size. But in Canada the field is almost entirely taken up by the fixed blade runner. A few Kaplan runners are used, but these are of small size.

If one is to search for the reason for this preference for the fixed blade runner in Canada, in spite of its inferiority to the Kaplan runner in maintenance of high efficiency over a great range of capacity, he will find several explanations. The fixed blade runner presumably is more rugged than the Kaplan runner, as the latter has numerous parts moving relatively to each other. Moreover, the fixed blade runner usually has as high, and in some instances, higher maximum efficiency than the Kaplan runner. If, then, the lower efficiency of the fixed blade runner at part loads is not a detriment, its mechanical advantages and high maximum efficiency may prompt its choice. As most of the installations in Canada form parts of large systems, it is often quite feasible to operate individual units always at high efficiency, the plant load being varied, as a unit is taken from, or put on, the line, by such amounts that all units operating do so at high efficiency. The operation of the Chats Falls plant on the Ottawa river illustrates what may be done in this regard. This plant, operating in the Niagara System of the Hydro-Electric Power Commission, is equipped with fixed blade runners rated at 28,000 h.p. under a head of 53 feet at 125

r.p.m. A study of actual operating results at this plant over several periods, each one week in length, showed an overall plant efficiency as high as 83 per cent. Manifestly, the turbines were operated at all times close to the point of maximum turbine efficiency to obtain so high a result as this for the whole plant.

In other instances in which high speed runers have been used, the governing condition has not been high efficiency, but rather reliability. The single unit in the Ear Falls plant on the English river in Ontario supplies mining load, and has been called upon for continuous service since it went into operation in December, 1929. In the intervening six years, the unit has been shut down only four times, for a few hours each time, for inspection and cleaning.

Welding of Turbine Runners

Considerable progress has been made in the last ten years in the art of welding in connection with the restoration of pitted parts of turbines. The corrosion and erosion of runner blades, throat rings, seal rings and draft tube sections have been experienced on high-powered, as well as on high-speed turbines, and this has, in many cases, proceeded to such an extent that replacement at considerable expense has been necessary. However, through careful investigation along scientific lines by special experts, welding processes now make it possible to save affected parts and restore them to efficient operating condition. Thus, for low maintenance expenditure, costly machines can be restored, instead of being replaced, and kept in service with little outage.

Cast steel and forged steel can be welded with little difficulty and, since rust-resisting materials have been applied, surfaces treated in this manner stand up very satisfactorily in service on turbine parts where pitting, due to cavitation, is unavoidable.

Successful maintenance work is now carried out on cast iron runners and cast iron throat rings with a welding process, which can easily be applied while such parts are assembled with the whole machine. Pitted cast iron parts are now filled with Monel metal, where previously a cheaper grade of welding steel was used. Several years of experience has proved that Monel metal is a good substitute to build up corroded parts on turbines.

Welding practice in connection with maintenance of hydraulic turbines is still in a state of flux and new processes, having certain advantages or special fields of application, are frequently being proposed and used. Among these might be mentioned the metal spraying process and atomic hydrogen process. Naturally, the product of any of these new methods, although giving promise of success, must be subjected to a testing period in service before the method may be accepted as worthy of approval.

Governors

Mechanical drives for governor flyballs have been almost entirely superseded by electric drives. The latter, as at first installed, were not free from defects and disadvantages; in fact, various devices were proposed and used to overcome the defects and assure greater reliability.

A separate set of transformers connected to the generator leads supply-

ing power directly to the governor drive give direct connection between the unit and the governing mechanism, even when interruption occurred which separated the unit from the system. This type of drive is advantageous with high speed flyballs, and finds frequent application at the present time.

A further advance was made by the addition of slip rings on the pilot exciter when available, from which a power supply was drawn for the governor drive. This method, although possessing advantages over those preceding it, was affected by disturbances in the main electrical system which were not related to the speed changes in the unit which the governing system is designed to control.

Apparently a power supply, quite independent of the main system, is desirable. The necessity for this prompted the development of a permanent magnet generator, directly connected to the main generator shaft, but independent of the main electrical system. The governor flyballs, being driven by power from this separate generating unit, are affected only by speed changes in the main generator shaft, and tend to operate the governor mechanism only as the speed of the unit departs from normal. Satisfactory results are being experienced in an installation of this type, replacing the earlier pilot exciter drive at the Alexander development.

GENERATORS

The use of rolled sections, instead of castings, in the fabrication of the frame and rotor of hydro-electric generators has become virtually standard practice. Improvement in welding technique and the development in rolled shapes have resulted in reduced weights, while the umbrella type of unit has tended to reduce power house superstructure volume.

A tendency to reduce the size of the power house superstructure is noted in several plants where the upstream wall is moved in much closer to the units than in the case of, say, the Queenston development. This tendency is seen in the Alexander and Chats Falls developments and the Rapide Blanc and La Gabelle plants in Quebec.

Beyond this, improvements in generator designs are noted mainly in details and in the excitation system. Advantage is being taken of experience to improve insulation, to prevent coil movement in slots under varying operating temperatures, and to brace the windings more securely to withstand short-circuit stresses.

The excitation system of large generators has undergone radical changes in the last ten years. The growth of interconnections and the generally longer transmission systems carrying large and important blocks of power have resulted in stability of operation becoming an important problem. One of the first measures adopted to improve stability was the so-called "high-speed" or "rapid-response" excitation system coupled with low values of armature reactance. While other measures are now considered of greater benefit in the relief of the problem, notably the extremely rapid clearance of faults, the generator excitation system quite commonly includes a pilot-exciter and high-speed voltage regulator.

The tendency to increase generator

voltages noted in other countries is not so marked in Canada, partly because only a relatively small number of new developments have been undertaken in recent years and partly because hydro-electric development in Canada almost invariably involves more or less long-distance transmismission. When a step-up transformation is involved in any case, there is not the urge to increase generator voltages as is the case when generated voltage distribution is involved.

The grounding of generator neutrals is a live subject in present-day practice. In a number of cases, where distribution at generator voltage is not present, generators are being operated with ungrounded neutrals. Damage occasioned by ground faults is thereby minimized, with no apparent countervailing disadvantages. Where distribution at generator voltage is present, the protection of the windings against lightning damage is receiving more attention.

TRANSFORMERS

The principal trends in transformer designs may be traced to the knowledge gained in recent years, as a result of extensive research in the field and in the laboratory into the problems of lightning protection, so that equipment as now designed is virtually lightning proof. The shielded transformer and the so-called "surge-proof" unit are products of this development.

As in the case of generators, refinements in design of transformers are being dictated by operating experience. The oil-insulated water-cooled unit continues to be used most frequently in hydro-electric installations, though the self-cooled unit supplemented in some cases by air blast finds favour where temperatures below 40 degrees F. are likely to be experienced. The forced-oil cooling system is practically unknown in Canadian practice.

Single-phase units are by far the most common, though several installations of three-phase units have been made where economical physical dimensions have apparently been the only limit to capacity.

Application of tap-changing devices has become almost universal practice. In the majority of cases these devices operate only with the transformer de-energized, but "on-load" tap-changing equipment has been developed to the point where standard equipment can be offered to meet almost any problem.

CONNECTIONS AND SWITCHING

The present tendency in station connections and switching facilities is definitely towards simplification and the elimination of duplication, as contrasted with the much earlier practice of double-bus arrangements and other more complicated diagrams.

This trend was no doubt initiated as development of more remote sites made necessary higher transmission voltages and, consequently, more expensive switching equipment. The generally smaller number of generating units per plant, the lesser need to provide emergency connections for single generating units as systems expand, and the increasing cost of switching equipment as vastly increased circuit interrupting speeds are demanded by modern interconnections, are all factors tending to maintain this trend.

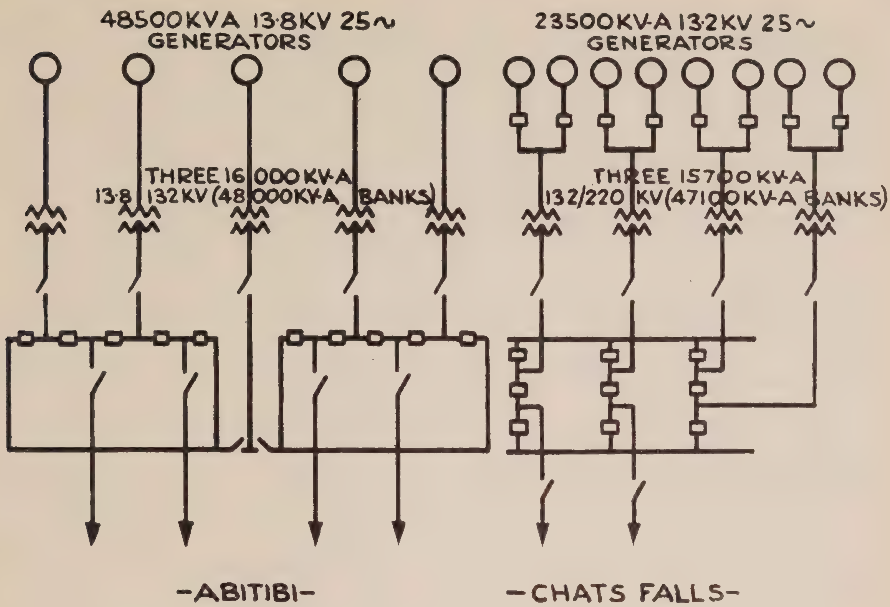


Fig. 2—Single Line Diagrams of Main Electrical Connections.

Allied with this simplification of connections, however, has been an expansion of the automatic relay protection afforded the component parts of the electrical equipment. Generator differential or split-phase protection, bus differential and transformer differential are among the types of protection applied.

In many plants, for example, at Chats Falls, Beauharnois and Abitibi Canyon, one or more generators and an associated transformer bank of the same total capacity are treated as a unit. Generator breakers, if used at all, are provided only between the unit and the transformer bank, while the high-voltage diagram may be of the "ring" type or the "1.5" breaker arrangement, both as shown in Fig. 2.

In the case of the Alexander development, high-tension oil-circuit breakers are entirely eliminated. The transformer bank capacity is arranged to equal that of one transmission line and forms an integral part thereof. This capacity must, however, be greater than that of the generating units connected to it, as, when a transmission line trips out, the station output must pass through the remaining lines and banks. The cost of this excess transformer capacity has necessarily to be weighed against the saving in high voltage switching equipment. A line diagram is shown in Fig. 3.

Where generator voltage switching equipment is used, the metal-clad type has found general favour, due to its compactness and its freedom from interference and outage. Such switching is invariably installed within the generating station, as the space re-

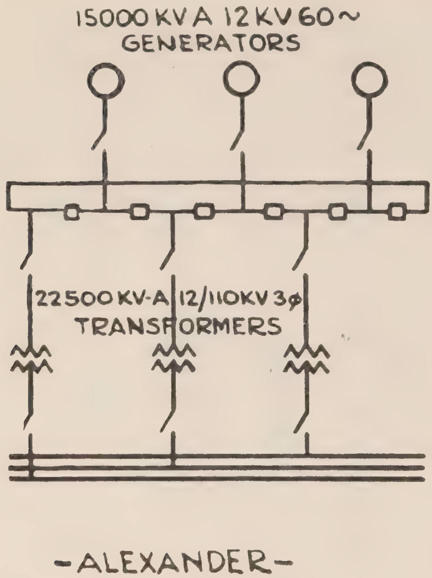


Fig. 3—Single Line Diagram of Main Electrical Connections.

quirements are small, though transformers and high-voltage switching have been almost invariably moved outdoors.

The developments in oil-circuit breakers in all voltage classes has been towards higher speeds of operation. These developments originate in various means of controlling the behaviour of the arc, and much progress has been made in breakers rated at 60,000 volts and above. Standard equipment in these voltage classes is rated to clear the circuit in 8 to 10 cycles on a 60-cycle system, while special high-speed equipment is available operating in 3 to 4 cycles.

Undoubtedly the trend away from massive oil-filled circuit breakers, so noticeable in European practice, is making itself felt in Canada. Up to the present, however, no noteworthy installations of apparatus incorporating radically new principles have been made. The tendency to curtail sharply the use of high-voltage oil-circuit breakers has, however, been largely responsible for a considerable improvement in the design and construction of no-load disconnecting and air-break switches. Such switches are quite frequently used to break transformer bank exciting current and the charging current of up to fifty miles of 132-kv., 25-cycle line, applications where previously oil-filled switches would have been considered almost essential. They are also successfully operating outdoors in temperatures ranging as low as 60 degrees F.

Control and Automatic Relay Protection

The recent developments in miniature type control switching and switchboard apparatus has brought about a radical change in the size and general design of all electrical control rooms. A compact main control board is provided, upon which are mounted miniature switches and the essential operating instruments. Control is by means of 24- to 48-volt control circuits to sub-control panels located adjacent to the main apparatus. Graphic instruments, relays and other equipment are mounted on these sub-panels.

This design reduces the space occupied by the essential features of the control system, thus greatly facilitating plant operation and reducing costs. As an example, the control room of the Chats Falls development, designed in 1930 to provide for the ultimate installation of ten units, occupies a space of 40 feet by 18 feet, the main control board including operat-

ing instruments, being only 12 feet long. By contrast the control room in the earlier Queenston development designed in 1920, also a ten-unit plant, is 70 feet by 74 feet, the main control board totalling 51 feet in length.

Control room lighting has been the subject of extensive investigation in recent years, in fact generally higher levels of illumination are found throughout the more modern plants. Air-conditioned and sound-proofed control rooms, virtually isolated from the generator floor, are becoming common practice, some form of control pedestal usually being provided adjacent to the unit, an operator on the generator floor performing the more simple operations of starting and shutting down the unit.

With the continued growth of transmission systems, the tendency toward higher voltage and consequently more heavily loaded lines, interconnections between generating plants and the generally higher grade of service the consumer has been educated to expect, the problems of load control, frequency regulation and the removal of disturbances by means of automatic relays have become more exacting.

Automatic frequency regulation and the corresponding automatic regulation of tie-line loading is gradually finding a place in Canadian practice, though more extensively applied in other countries.

Extremely rapid clearance of line and station disturbances, while retaining proper selectivity, is the object of modern relay applications. It is expected that practically complete solution of stability problems in high-voltage long-distance 25-cycle transmission will be effected by the combination of these relays with the high speed breakers discussed above.

Relays for this service usually operate on the impedance or reactance principle, the mechanical designs having been improved to the point where one cycle operation has been obtained. The application of pilot type relaying, where the action of the distant end relays may be controlled by impulses of carrier frequency transmitted over the power circuits, is growing to meet the needs of more complicated system connections. Pilot type control appears to offer a satisfactory solution to such problems as "branched" or tapped lines, for which no other high-speed types have been found to be entirely suitable.

In general, the necessary potentials for the operation of these relay types are obtained from two-winding transformers. The potentiometer type of potential source, utilizing capacitance principles, is, however, finding increasing service in a number of ways; for example, in re-synchronizing high-voltage lines at main receiving stations following an automatic trip-out.

In summary, the electrical side of hydro-electric development is growing in complexity as the demand for power increases. As the number of generating stations operating in parallel increases, either normally or under stress of emergency conditions, so the associated transmission systems become more complicated. To counteract this tendency, the development itself is being designed to effect the maximum possible simplicity.

Designs incorporate in general the minimum number of units (single-

unit plants are not uncommon), the most simple electrical connections, with the control removed from human hands in so far as possible by the application of automatic devices. As these trends of themselves tend to promote economical devolpment of available sites, it is to be expected they will continue.

Conclusion

Interconnection of plants and their separate transmission systems, resulting in the building up of large distribution networks in the more populous parts of the country, had a profound influence upon the design and operation of hydro-electric development ten to twenty years ago. Some of the problems of speed regulation and of pressure regulation in long conduits were partially solved by this tendency, more efficient use of limited water supplies was effected, and development of certain sites made economically advantageous. The design of plants to meet the requirements of industry in remote parts of the country has brought about a return to many of the earlier problems of design. Many of the plants so built are quite isolated from all others and must therefore be designed for continuous and reliable service, frequently under very adverse conditions. Reference has been made already to one plant in Northern Ontario, where continuous service has been given for six years with no opportunity for interruptions for maintenance. Moreover, load variations were such as to make much more severe demands on the governing system than would be the case in plants giving ordinary central station service.

Extensions of transmission systems into many mining districts are taking place, the same tendency toward interconnection of isolated plants and systems being observed as took place in industrial districts some years ago. Large areas in Northern Ontario and Quebec, dependent mainly on mining activity, are now covered by an extensive transmission network.

St. Thomas Public Utilities

THE public utilities in St. Thomas, which formerly operated under separate commissions, were brought under the control of what is known as the St. Thomas Public Utilities Commission early in 1935. This included Waterworks, Hydro-Electric, and Gas Departments. The several departments were operated under the supervision of the different commissions appointed at the beginning of the year, until the new commission was appointed during August, which assumed control of all departments. On October 6th, 1936, the manufacture of gas was ended and the system sold.

The story of St. Thomas dates back to 1810, when settlers first began to move into that district. About 1825 there was the beginning of a village, which by 1852 had a population of

about 1,300. At this date the Village of St. Thomas was incorporated. In 1861 it became the Town of St. Thomas. Up to 1870 the growth of the population was slow; being less than 2,000 at that date. When the railroad was projected through St. Thomas there was a much more rapid increase in the population, which in 1876 numbered about 6,000 people. In 1881 St. Thomas was raised to the status of a city, which now has a population of over 16,000. St. Thomas was named after Thomas Talbot, a pioneer settler of the district, with the saint added for euphony.

A water system for fire protection was installed in 1874 which was given a public trial on December 16th of that year. A dam was built across Kettle Creek and the water passed by a sluice-way into a reservoir of stone laid in water lime. An engine and pump house was built over the reservoir which housed two steam boilers and two engines of 40 horsepower each. The accepted tender for this installation was $23,543.60.

From this beginning the St. Thomas waterworks system has grown, which, in addition to providing water for fire protection, supplies about 4,500 consumers. Water is now pumped by four 175 horsepower electrically-driven pumping units and four 175 horsepower gasoline standby units. Approximately 508,000,000 gallons are pumped yearly, and the plant value has grown to about $940,000.00.

The St. Thomas Gas Works was first built in 1874 on a contract for $59,700.00 and was the property of a company of citizens. The system then contained about three miles of pipe and supplied street lighting, lighting for the public buildings and many private residences. In the year 1887 the St. Thomas Gas Company secured an enlargement of its powers and installed a Thompson-Houston electric light plant. In that year the Company entered into an agreement with the Town of St. Thomas to supplement the gas street lighting system with a number of electric arc lamps. These new arc lights were located along Talbot Street, although a few were erected in the outlying districts. The charge for arc lights was 22 cents per light per night on Talbot Street and 25 cents on other streets. At the outset the Company supplied current to twenty-two street lights as well as to a few private users. In 1896 the City Council gave some consideration to the matter of inaugurating a municipal electrical department. An itemized report of the estimated cost was submitted by the then City Engineer which was followed by a report on an electrical street lighting system by his successor. No action followed, however, until 1905 when the city bought out the plant of the St. Thomas Gas Company for the sum of $100,000.00.

As time went on the demand for electricity increased rapidly, and it was not long before the city found that boiler capacity was at a premium, especially on Saturday evenings. However, the solution of the difficulty was being developed in the creation of the Hydro-Electric Power Commission of Ontario. St. Thomas was one of the original fourteen municipalities to contract for power through the Hydro Commission, the amount being 1,500

horsepower. In April, 1911, St. Thomas began receiving power from the Commission and in October of that year took a maximum load of 469 horsepower. During 1935 an average load of nearly 6,300 horsepower was taken.

St. Thomas street railway had its beginning in 1879 when an agreement was entered into between the Town of St. Thomas and the Railway Company covering a transportation service comprised of horse-drawn vehicles on rails. Clause 6 of the agreement reads: "When turning corners from one street to another, the horses or mules attached to the cars shall not be driven faster than a walk". In 1897 a revision of the original agreement provided for the electrification of the street railway and as a result of electrification, the street railway became a substantial user of electricity purchased from the St. Thomas Gas Company. In 1904 the street railway was taken over by the city who operated it for a number of years until the changing conditions of transportation eventually made it no longer necessary, and so was abandoned.

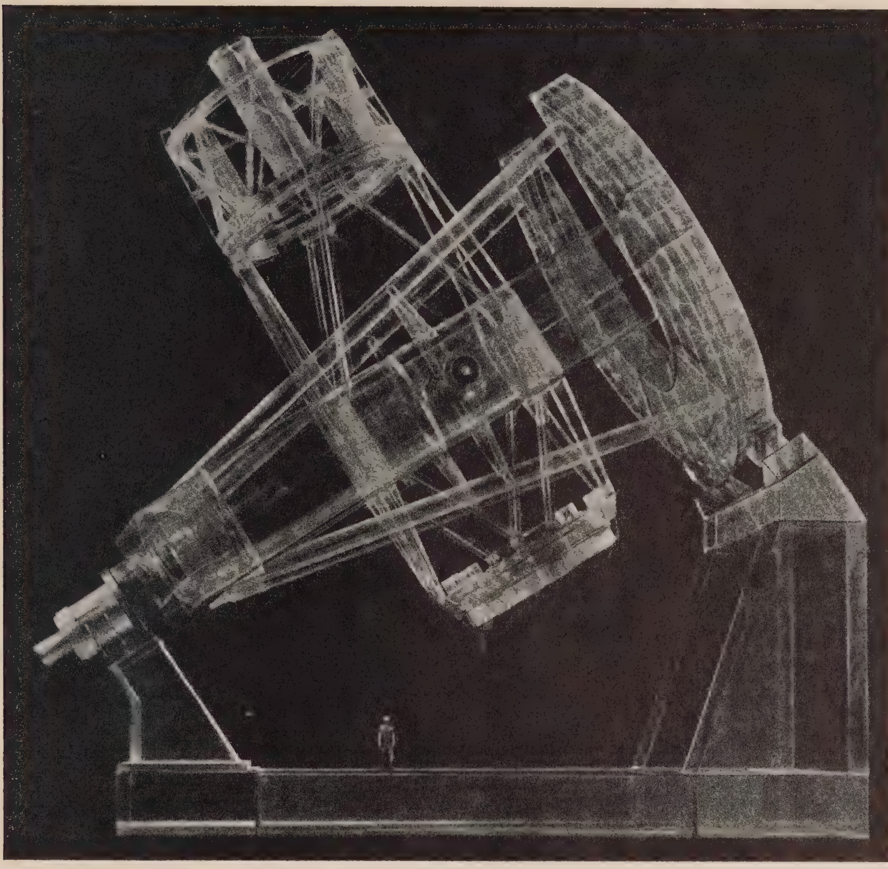
New Celestial Eye

IF one can imagine the steel skeleton of an eight-storey building so delicately balanced on bearings that it can be turned by hand, and suspended within it the steel structure of another eight-storey building that can be rotated in pinwheel fashion, one will get a rough idea of the size of the new 200 inch telescope which will be erected at Mount Palomar, California. When completed, the moving parts alone will weigh 1,000,000 pounds. When these are mounted, a hemispherical dome 135 feet high will be required to cover the apparatus.

One of the chief problems in construction of this structure is the infinite precision required. Tall buildings may sway as much as a foot without causing inconvenience to the occupants. But in the telescope structure a deviation of one thousandth of an inch must be known and care must be taken to offset it. It is estimated from preliminary tests that deviations due to strain in moving the parts will not exceed the millionth part of a circle.

Before work started on the large telescope many models were built with which to make tests. One of these was a construction in cellophane, built to a very high degree of accuracy as to both size and distribution of weight. This model was submitted to rigid tests with polarized light. When glass or cellophane structures are subjected to polarized light tests, darkened lines show where stress occurs. On the basis of results from these and other tests made with an actual telescope one-tenth the size of the large one, the huge structure was designed.

So great is the precision exercised in the design of this astronomical masterpiece that a motor of only one-quarter horsepower will be employed



Scale model of 200 inch telescope constructed in cellophane.—"The Sky".

to move it. Even this, according to Jesse Ormonroyd, Westinghouse engineer in charge of construction, has power greatly in excess of the amount required for the task. A motor of 1-165,000 of a horsepower, or the motor of an ordinary electric clock would be sufficient to move it, says Mr. Ormonroyd. Even the pressure from a child's finger would move the giant framework.

This almost complete freedom from friction is obtained by a thin film of oil pumped through the bearings at a pressure of 250 pounds to the square inch.

Mount Palomar observers, with the aid of this new telescope, will be able to photograph stars 1,000,000,000 light years away and will have access to a volume of space eight times as great as that available to the observers at Mount Wilson with their 100-inch telescope. This latter has a range of 500,000,000 light years.

The new telescope, costing $6,000,000 will be paid for by the Rockefeller Foundation.—*Canadian Comment.*

Hydro-Electric Progress in Canada in 1936

THE annual review of hydro-electric progress in Canada prepared by the Dominion Water and Power Bureau, Department of Mines and Resources, discloses that, although a comparatively small addition was made to the total developed water-power capacity in the Dominion during 1936, there are a number of developments actively under construction which will add materially to the total in the next year or more. New installations during 1936 aggregated 36,475 horse-power, bringing the total for the Dominion at the end of the year to a figure of 7,945,590 horse-power.

The programme of hydro-electric development throughout Canada during the past few years has been largely influenced by conditions brought about by the recession period 1930 to 1933. Prior to 1930 a number of major developments had been placed under construction with a view to keeping pace with the demand for power which had been growing steadily for some years. This growth in demand, however, ceased in 1930 and was replaced by a recession which continued until April, 1933. In the month of May of that year the demand again turned upward and has continued to do so month by month to the present time. Notwithstanding conditions in the years of recession much of the construction, being well started, had to be proceeded with and gradually brought to completion, thus providing a generating capacity in excess of existing power demand and rendering unnecessary for the time being the initiation of new projects. The spread between installed capacity and power output has been rapidly narrowing in the past three years.

In this connection the monthly figures of output of central electric stations compiled and published by the Dominion Bureau of Statistics are of special significance. Month by month in 1936 these figures have shown a substantial increase over the figures for the corresponding month in 1935 and for the ten-month period for which statistics are available in 1936 an aggregate increase over the corresponding period for 1935 of nine and a half per cent. has been shown.

The new installations in 1936 comprised, chiefly, additions to existing developments such as the High Falls plant of the Maclaren-Quebec Power Company on the Lievre river, the Rat Rapids plant of the Ontario Government on the Albany river at the outlet of Lake St. Joseph and the Ruth Falls plant of the Nova Scotia Power Commission on East River Sheet Harbour. Several small installations were also completed in British Columbia.

The principal activities in hydro-electric development in the various provinces are described hereunder.

BRITISH COLUMBIA

New water-power installations in British Columbia were four in number. Quesnel Light and Power Com-

pany completed a 200 horse-power hydro-electric plant on Baker Creek near Quesnel and this is now supplying power to the town and vicinity. Hope Utilities Limited installed a 50 horse-power plant on Schkam Creek near Hope which is now supplying power to that village. The Canadian National Railways installed a 100 horse-power plant on Stoyoma Creek to supply electrical energy to the railway shops and premises at Boston Bar. The Ashloo Gold Mining Company has installed a 75 horse-power Pelton wheel for the purpose of supplying compressed air for mining purposes. This installation was actually completed in the fall of 1935, but is included in this year's total as information concerning it was not available last year.

Ontario

In Ontario, development was confined to the north-western section of the province. The Hydro-Electric Power Commission of Ontario which completed the construction of and operates the Canyon (Abitibi river), and constructed and operates Ear Falls (English river) and Rat Rapids (Albany river) stations as trustee for the Provincial Government brought a new unit of 1,750 horse-power into operation in the Rat Rapids station early in October and is proceeding with construction to provide for the installation of a second unit of 5,000 horse-power in the Ear Falls station during the coming year.

The Commission acquired by purchase during the year three plants on the Trent Canal System at and near Lakefield. These three plants have a combined capacity of 4,200 horse-power and will be operated to augment the power supply of the Commission's Eastern Ontario System.

Consideration was also given by the Commission to the development of a 10,000 horse-power site at Ragged Rapids on the Musquash river to augment the supply of power to its Georgian Bay System and also to further development on the Madawaska river for its Eastern Ontario System.

The Great Lakes Power Company has constructed a dam and power house on the Montreal river which will be interconnected with its other plants at Sault Ste. Marie and Michipicoten Falls. The initial installation is 10,000 horse-power and is expected to be in operation early in 1937.

Quebec

The only additional installation in the province was that of a fourth 30,000 horse-power unit at the Maclaren-Quebec Power Company's hydro-electric plant on Lievre river at High Falls, bringing this development up to its full capacity of 120,000 horse-power.

New Brunswick

No new hydro-electric installations were undertaken in New Brunswick during the year but the New Brunswick Electric Power Commission completed the new 6,250 kilowatt turbo-generator additions to its fuel-power station at Newcastle Creek.

Nova Scotia

In Nova Scotia, the Nova Scotia Power Commission has completed the 4,300 horse-power addition to its Ruth Falls plant on East River Sheet Harbour.

John Broadbent Talks on Hydro

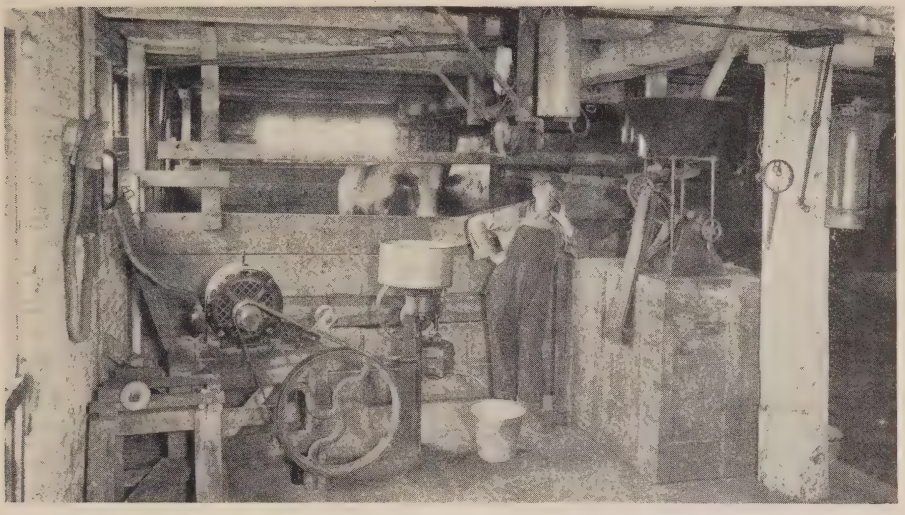
IT was raining: one of those cold November rains turning at times to sleet. All day the sky had been dark, and although it was comparatively warm, a rising wind had given added warning of the storm which had finally arrived. One could hear the drive of the storm against the stable windows, while the running of water from the eaves was heard above the feeding of the cattle. I had worked in the fields as long as the fast-fading daylight would permit, and had managed to finish the last of the ploughing, a job which had been made easier by the late rains. After stabling the horses I had gone to partake of a waiting supper, returning to the barns again to finish the evening chores.

A number of years ago I had been persuaded to instal Hydro on my farm, and once again I was really appreciating the comfort and conveniences of this wonderful service in the barn. As I left the house with its brightness and warmth a short time before, I turned a switch in the back shed which caused a light on a pole in the yard to come on. As I threw the last forks full of feed into the mangers and went my rounds to see that everything was made snug and fast for the night, I could still see that light out there in the storm like a beacon ready to light the way back for me.

It was a night when one could not help recalling the old lamp and lantern days, and as I worked at the chores keeping company with my thoughts, many comparisons naturally took form in my mind. I thought of the days when the smoky old lantern hung from a nail while I hurried through the chores in order to get out and away from the gloom and shadows of the barn, or else quit work in the fields earlier in order that the chores could be done before the fall night came on, thus shortening the working day. Now, the most pleasant work of the day was the hour or so spent with my animal friends in a barn made bright and comfortable with electric light. I remembered, too, the trip from the barn to the house with the same smoky lantern, in a similar storm.

LIGHT AND COMFORT IN THE HOME

With the chores finally done and the lights turned off in the barn and the hen-house where they had been burning, shortening up the long fall night for the laying hens (a scheme which I found paid handsomely), I took my way back to the house. There I found that the supper dishes had been taken care of and the two younger children were busy at their evening studies at the kitchen table. Again memory returned to me a picture of a night six years ago when a Rural Superintendent called at my home and, seeing the two older children crowding as close as possible to the old oil lamp in order that they might see their work, begged me to sign that card which would be the beginning of a new era in our



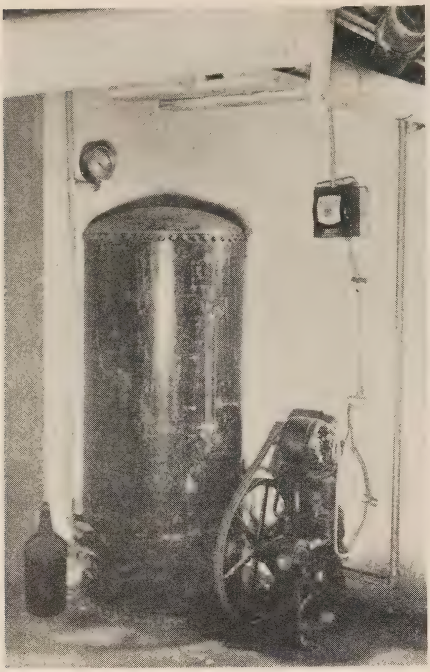
home, and for the sake of my family I signed it.

This Hydro, by means of which we light the houses, the barns and the yards, is like the water in the well, so dependable that it has been taken into every department of our home life, and at times we apparently think that, like the water in the well, we should have it for next to nothing. I am saying this here, for I had no sooner started a little speech of appreciation of the fact that, in spite of the storm, our lights still burned without a flicker, than my wife took the opportunity of reminding me of a Hydro bill almost due. My wife's reminder of the Hydro account again started us off on that favourite topic of conversation, or one might better say, argument, as to the why and wherefore of our Hydro charges. In order that in the future I might have the better of this one argument at least, I made up my mind to visit our local Hydro office and pay my bill next day, so that I might take advantage of the discount and make my visit to the office an excuse to see our local Superintendent.

As I met our Superintendent, he obligingly asked me into his office that I might better give voice to my complaints. For some reason or other I believe he sensed the fact that I had something to unload. After asking him, with none too good grace I am afraid, what those charges were all about, he smiled slightly, and, from that smile, I was led to believe that I was neither the originator of that question nor of the manner of asking it. Then he started to do something that I had not seen done before. He took the bill and, in a simple, straightforward way, explained to me reasons for the service charge and the different items that combine to make it, and also the reasons for the first, second and new third rate in the power charges.

WHY THAT SERVICE CHARGE

He told of how, after the Government had paid, outright, half the total costs of our rural Hydro lines, there



was still left an obligation to the Hydro user to pay his share of the interest and sinking fund on the remainder of the cost. This sinking fund is the money which is put away to pay off the original investment. And then there is money required for the necessary repairs and renewal of the lines, as well as the cost of operation which includes the reading of the meters, the billing, etc., which is all part of the service charge.

He also called to my remembrance the fact that, a number of years ago, a small red brick building called a substation was erected on a lot not far from our farm, from which the rural Hydro lines radiate. This substation, through which the power is reduced or stepped down to the rural line voltage, is served by another high voltage station several miles away, through a high voltage wood pole line. From the great generating plant at Niagara Falls, where the electricity is generated at so much per h.p., heavy, high-power lines on steel towers radiate throughout the province. One of these lines passes near the city and from this line power is delivered at the high tension station where the power is stepped down to go out to the smaller substations. He showed me that all this equipment was necessary for the transportation or transmission of the power manufactured or generated at the Falls, and that the cost of the power at the Falls, plus the cost of the rural power districts' share of the transmission costs of the power delivered at the little red substation, determined the cost to the consumer in the particular district in which he is located. Of course, I could see that as more power was taken through these small substations which are built to take care of a much larger demand, the cost per kilowatt-hour to each one of us would be less. I suppose that is the real reason back of the effort that the Hydro makes to encourage us to use more electrical equipment and to get more Hydro users on the line, and so, as I said before, I began to understand to some extent, the reason back of that other part of our bill—the cost per kilowatt-hour.

THE KILOWATT-HOUR EXPLAINED

A kilowatt-hour, I was told, is a standard unit of electrical measurement. Kilo is a word derived from a Greek word meaning thousand, and a kilowatt is 1,000 watts. A kilowatt-hour is one hour's use of 1,000 watts. For instance, a 40-watt lamp has to

burn for 25 hours before it uses one kilowatt-hour, or, five 40-watt lamps, using 200 watts in an hour, would have to burn for 5 hours before they burned one kilowatt-hour. As this is the size that I use mostly in the stables, it must just cost me about one cent a night for the barn lights. That light out in the yard is a 100-watt lamp. It burns for ten hours before it uses 1 kilowatt-hour, and, I have figured that the radio uses one cent's worth of Hydro in 7 hours, and the washing machine runs for 4 hours for two cents. Well, I always had been enthusiastic about the things Hydro did for us, but this explanation made me more so.

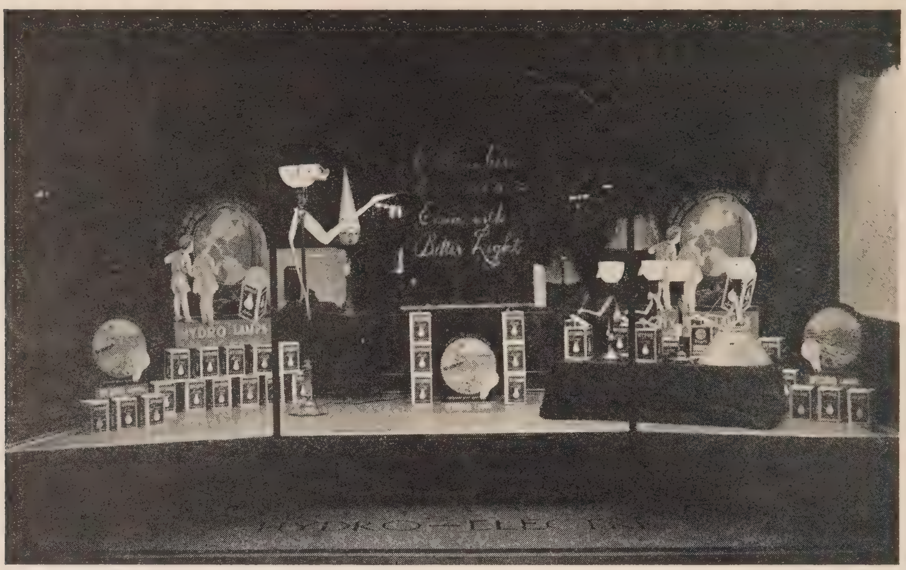
Reduced Rates

At the time I visited the local rural office, rumours were current that, as a result of certain economies in the purchase of power and in the financing of rural Hydro lines, we might expect a reduction in our Hydro bills. Now the news has come out that all farms, excepting those taking heavy power, are to have the same service charge of $1.00 net per month, and I cannot help thinking of that good neighbour of mine down the road, Jim Acres. Jim had always felt that he could not afford to instal the Hydro and pay the Hydro bills, and I am afraid we didn't give him much encouragement. Although Jim and his wife were hard workers, it has been all they could do to keep their heads above water during the lean years. They carry a mortgage, and with their family expenses, I know they have had tough going. I know just how he feels, but, as I look back over the past few years, I can see that even through the hard times, Hydro has been a most wonderful help and has never failed to pay its way.

Now, the Hydro Commission has brought the price down to where even Jim cannot afford to be without it. I know that with the increase in the price of all the things we have to sell, he could at least wire his house now. If he hasn't the cash, he could take advantage of the Government Home Improvement Plan by talking things over with his local banker, and then he could wire his barns and yards next fall if he can't do them now.

I wish that we, as neighbours, had persuaded Bob Jennings on the next concession to wire up. Bob had a chance but for some reason passed it up. One night in late October, while feeding his horses, he, in some unaccountable way, hit the lantern which had been hanging from a hook overhead, and knocked it down. In spite of his efforts to put out the fire which started, he lost his good barn and all its contents, with the exception of the stock which he managed to save.

One thing which was drawn to my attention on the day of my talk in the Hydro office, was the fact that the Hydro, right from the start, had been a co-operative movement. In the early days of rural Hydro, the farmers themselves had gone out and persuaded their neighbours to sign up for Hydro, and in this way many of the districts were started. Now that the charges are so low that not even the poorest among us can afford to be without it, I feel that we, as users, should help to spread the good news of Hydro.—J. W. B., in the *Farmers' Advocate.*



Better Light Display by Belleville Hydro

A RECENT Lamp Window of the Belleville Hydro-Electric Commission created much interest.

Some of the features possibly not so readily discernible in the small reproduction in this issue may be worth noting. The theme of the display is the necessity for adequate light when teaching. You may note that the teacher was equipped with glasses, possibly necessitated by inadequate light in the early days of his learning period. The dunce is also depicted with glasses and possibly poor seeing is the cause of his predicament. The group of scholars so attentatively at their work in adequate lighting conditions is worth noting. The blackboard also depicts the seeing advantage to the pupil of plenty of light.

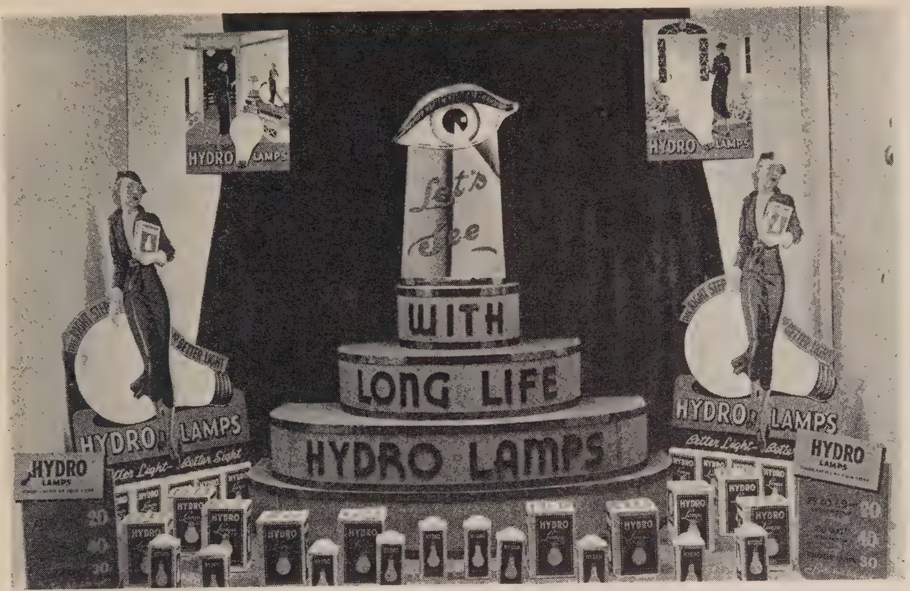
The two top lines, "Children Learn to Read and Write" are not nearly as well illuminated as the two lower lines "Easier with Better Light".

Some of the novel features are the use of a Tri-Light for the teacher and the I.E.S. Student Lamps less the shades as the students. The Hydro Lamp cartons certainly supply the students with a good desk. The Hydro Lamps a source of good light.

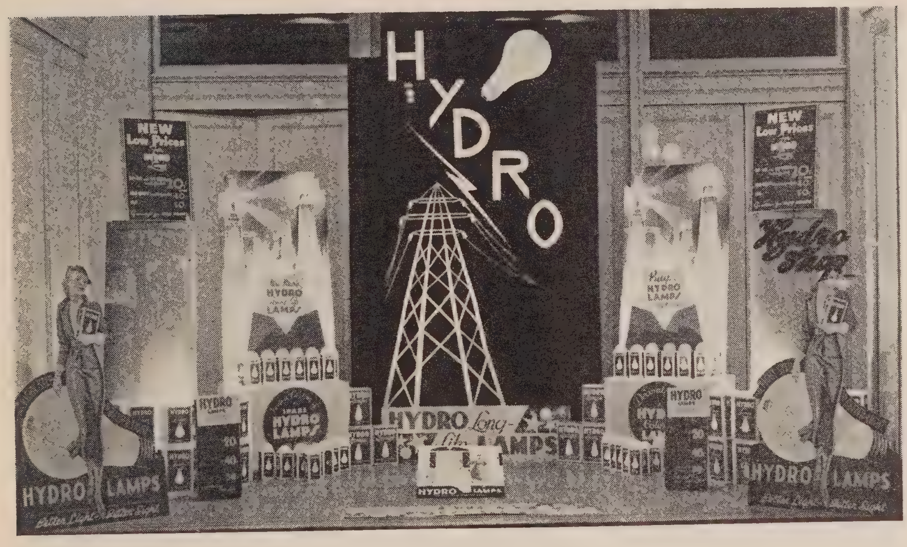
Mr. Everett Smith of the Belleville Hydro-Electric Commission staff was responsible for creating the display and is to be commended.

Hydro Lamp Window Dressing Contest Awards

The 1936 Annual Hydro Lamp Window Dressing Contest produced



First Prize, Class I, Windsor Hydro-Electric System.



Tie Second Prize, Class I, Hamilton Hydro-Electric System.

the usual high standard of entry.

This contest does much to arouse a keen sense of rivalry between Hydro Shops in window display effort.

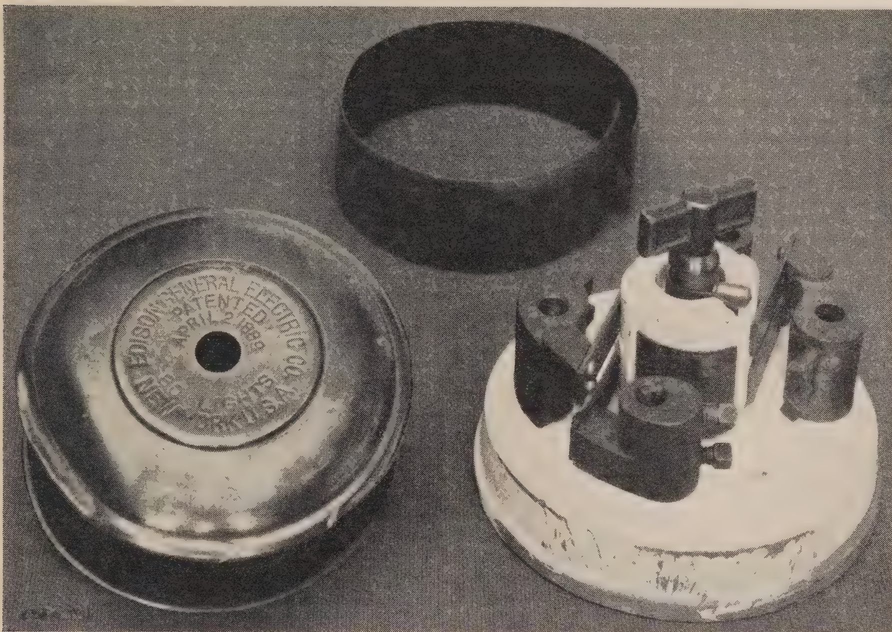
Those who entered had the added gratification of noting a marked in-

Tie Second Prize, Class I, Toronto Hydro-Electric System.

Third Prize, Class I, London Public Utilities Commission.

crease in the sale of the merchandise displayed.

Class 1 winning windows are reproduced herewith.



A Snap Switch of the Victorian Period Design

By E. W. McLeod, Testing Engineer, H.E.P.C. Laboratories

IN 1896 the snap switch illustrated was installed as a service entrance switch in the Methodist church at Aylmer, Ont. It was removed from service in 1929, not because of defect, as it was in excellent condition, but on account of replacement with modern equipment.

From the information embossed in the metal cover it is interesting to note that evidently there was no appreciable concern about modern volts and amperes, as the switch was rated simply "80 lights". However, there seems to have been quite apparent concern for reliability of the switch in service as evinced by its rugged construction.

The illustration possibly does not do the switch full justice as, at first sight, it might be confused with the well-known modern surface type snap switch. The following construction details may, therefore, be of interest:

Overall diameter .... 5½ inches
Overall height .... 4½ inches
Total weight .... 4 lbs.
Weight of the four metal wiring terminals and switch blades .... 2 lbs.

An examination of the switch indicates that even in those early days

(patented 1889) of the electrical industry, the value of many features of design which have survived to the present was appreciated. Some of these features are:

(i) quick-make-and-break switch operating mechanism.

(ii) relatively high-pressure contact at switching contacts.

(iii) the arc-suppressing value of porcelain when used in the zone of an electric arc.

The switch will eventually be housed in the Commission's museum.

Resusication from Drowning at Campbellford

Kenneth Cairns

On the evening of July 4th, 1936, a young boy, Charles Martin, was fishing off the dock at Campbellford, Ont., when he slipped off the dock into deep water. Walter Sutton, Lock Master of the Department of Railways and Canals, was called to the boy's assistance and after a number of attempts to find the boy, was able to pull him up with a pike pole. Kenneth Cairns, an operator of Hydro-Electric Power Commission at Campbellford, was called, and after carrying out artificial respiration for some time, was able to bring the boy back, breathing.

In this accident, it is interesting to note that twelve minutes had elapsed between the time the boy fell into the water and was brought up by Mr. Sutton.

The facts in connection with this case of successful resuscitation were placed before the National Safety Council and that body awarded the President's Medal to Mr. Cairns.

At Campbellford, on December 15th, 1936, a luncheon, attended by some 25 representatives of the Hydro-Electric Power Commission, was held. Alderman Alex. McColl represented the Mayor of Campbellford and welcomed the visitors. H. M. Carr, M.L.A., spoke at some length as to how proud the citizens of Campbellford and the district were, not only of Mr. Cairns but of the general assistance given by the local Hydro employees in cases of emergency. He publicly thanked Mr. Cairns and congratulated him on the award. G. B. Smith spoke in connection with the excellent work that had been done. The Medal and Certificate of the National Safety Council were presented by Wills Maclachlan, acting for the President of the National Safety Council.

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Address on Hydro

Delivered by the Honourable A. W. Roebuck, K.C., M.L.A., Attorney-General and Hydro Commissioner, to the Legislature of Ontario on January 20 and 21, 1937

THE management of Hydro during the past year has been characterized by great activity and by unparalleled success. It may be recalled that when I made my address to the House two years ago the picture I painted was one of darkness and gloom. Contracts for enormous quantities of unusable power had been entered into with private companies, on terms so unwarranted as to shock the conscience of the Province when the true facts were at length laid bare, and at prices much too exhorbitant to be justified. It will be recalled that I told at that time of advancing prices to the consumer, accompanied by staggering losses on the operation of Provincial Hydro finance. The average cost of power in the Niagara system had advanced by nearly fifty per cent. in five years, or $9.00 per horsepower, from $20.84 per horsepower in 1930 to $29.68 per horsepower in 1934, and the deficits charged to the Obsolescence and Contingency Fund had been

$2,500,000 in 1932.
4,200,000 in 1933.
2,800,000 in 1934.

Financial conditions in the other systems were also unsatisfactory. The agreements for the purchase of power for the Eastern system from the Gatineau Company, were much in excess of requirements, and the subsequent purchase of the Galetta and Calabogie plants and the undeveloped power on the Madawaska river from the M. J. O'Brien interests for $1,800,000 provided a usable 2,000 horsepower at interest charges on the $1,800,000, of $108,000 per year. This had been offset by increases in the price of power so that the system was not actually in the red, but prospective increases in deliveries from Gatineau, irrespective of the system's requirements presented a discouraging prospect of future finances.

The revenue of the Abitibi division

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The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

of the Northern Ontario properties for 1934, was little more than fifty per cent. of the expenses, and the deficit reported was $479,000, and the net deficit that year of all the Northern systems combined was $338,000. Other systems were in reasonably normal condition.

The present Commission had taken office in the previous July, and had at once proceeded with a campaign of economy, but administrative savings could not in the nature of things be sufficient to overcome the losses in Northern Ontario, on the Madawaska, and in connection with the Eastern power companies. This situation appeared hopeless.

Old Contracts Declared Unenforceable

I need not remind the House that when informed of these facts, this Government, with the unanimous support of its following, declared by legislative enactment the power contracts to be void and unenforceable.

The Act of cancellation did not, however, come into force until December 6, 1935, so that in the Session of last year I was again under the necessity of reporting unsatisfactory conditions of high power costs and continuing deficits, but with, however, a vast change in the general picture. Last year the gloom was dispelled by expectations of future success. During the first full year of the present Commission's management, that is, 1935, revenue was increased by $684,000, or 3.2 per cent. over the preceding year, while the expenses of operation, interest and exchange had been reduced by $656,000 over the previous year of 1934—a total gain of $1,340,000, but nevertheless, due to the continually increasing amount of power to which the Commission was committed under the contracts, the deficit in the Niagara system for 1935 was $2,878,000—within $9,000 of the deficit of 1934.

Eastern System Contracts Also Unsatisfactory

The revenue of the Eastern system for 1935 had also increased by $77,000 over 1934, and in addition there had been a decrease in the system's expenses of operation, interest, other fixed charges and exchange of $44,000. The system's actual requirements for power were, at that time, not in excess of 42,000 horsepower, but by the first of October, 1935, deliveries under the Gatineau contract had grown to 48,000 horsepower, and the payment for the excess of deliveries over actual requirements ate up, for the most part, the beneficial

results of the new Commission's management, as evidenced by increased revenue and decreased expense.

DEFICIT IN NORTHERN ONTARIO

While a satisfactory growth had been experienced in Northern Ontario in 1935, the Abitibi division still showed a deficit of $272,000, without charging the usual reserves for their obsolescence and contingencies, or sinking fund, and the deficit of the combined Northern Ontario properties under these conditions, was $145,000.

SITUATION NOW MUCH IMPROVED

Now, however, it is my privilege to report to the House this year, a financial situation in marked contrast to the gloomy conditions inherited from previous years. The policies of the Government and the Hydro Commission have borne fruit —fruit that is not only luscious to the eye, but full of meat and substance. Deficits have been abolished in every system, and in their place are drastically decreasing rates, increasing revenues, relatively decreasing expenses, and mounting favourable balances. This is the banner year, to date, in the history of Hydro.

* * * *

NIAGARA SYSTEM

As Provincial Hydro is divided into six great systems, each with its individual accounts and separate financial responsibilities, it will be necessary for me to refer successively to each one of the units. I will, therefore, commence a series of analyses with a discussion of what is known as the Niagara System. The territory comprised in this system lies north of lakes Erie and Ontario, and extends from the Detroit river on the west to a line running north from Whitby on the east. It extends northward to a line drawn east and west approximately touching the southerly shore of lake Simcoe. This is the greatest industrial district in all Canada, as it includes the cities of London, Windsor, Hamilton and Toronto, and has a population of over 2,000,000 people.

SYSTEM LIABLE FOR EXCESSIVE PAYMENTS

When this Government took office its Hydro Commission found the Niagara system obligated to the purchase of 731,000 horsepower at $15 per horsepower from the Gatineau, Beauharnois, Maclaren, and Ottawa Valley Companies. In gross figures the system was liable to payments aggregating $382,500,000, or $172,000,000 more than the total assets invested in the whole system. We had paid since the commencement of the deliveries under the first Gatineau contract in 1928, the outlandish sum of $33,500,000, most of which was absolute waste. In 1935 we actually paid to these companies the sum of $7,936,893.70, and in the year that has just closed of 1936, we would have been obligated to a payment of $9,517,500. In the current year of 1937, when all deliveries would have been complete for the full year, the obligation would have been $10,965,000, and so on from year to year.

RESERVES STEADILY DEPLETED

We found our reserves being drawn on at an average of over $3,000,000 per year, and we calculated

that by the end of 1936 our contingency fund, which stood at one time at over $14,000,000 would be completely exhausted.

It is not natural that one should rely with the same implicit confidence on estimates and forecasts as upon the proven facts of past accomplishment. When we as a legislature approached this problem for the first time in the Session of 1935, we were forced to depend upon estimates as to the amount of surplus power, the actual requirements of the system, the ability and cost of our own plants to produce, and the probable effect upon the balance sheet of cancellation or non-cancellation. The facts which I then stated as theories are now proven in experience, and they demonstrate beyond question the desirability of protecting that which we have gained, by all lawful means within our power. With this in mind, may I now report to this House the gratifying results of our policies.

Picture Now Greatly Changed

With the cancellation of the Eastern power contracts, the picture in the Niagara district has drastically changed.

I have told you that the cost of Eastern purchased power from the four companies last year amounted in actual cash paid out, to the sum of $7,936,892.70; and had the contracts not been cancelled the cost in 1936 would have been $9,517,500. What we actually paid under the terms of the new contracts for power actually received or held in reserve was the sum of $2,823,906.74—a saving of $6,685,583.57. The Eastern power contracts were cancelled on December 6, 1935, but it was not possible to discontinue at once the entire unprofitable load which had been accepted by the Hydro Commission in an endeavour to dispose of excess power. A reasonable time was required in which our customers might accommodate their operations to new conditions, and accordingly the Commission continued the purchase of approximately 100,000 horsepower which it sold at from $2.30 to $2.40 per horsepower for the generation of steam in competition with fuel-fired boilers. This was continued until the 30th of April, 1936, at a cost for 1936 of $550,000, for a revenue of $143,000, and the net figures for the year are accordingly reduced $407,000. Aside from this incident, however, the Commission has accepted delivery from the four companies of 140,000 horsepower only of the 731,000 horsepower of former commitments.

Niagara Generation Increased

In 1934 our three Niagara plants generated 2,777,581,000 kilowatt-hours, while in 1936 there was generated 3,669,622,000 kilowatt-hours, an increase of 892,000,000 kilowatt-hours. There was accordingly an increase in cost of operation and maintenance of generating plants in 1936 over 1935 of $87,000, and water rentals to the Ontario Government of $98,790. But against this increased cost there was a saving, in addition to the increased output of our plants, in lower line losses as a result of the shorter transmission from Niagara to Toronto, as against the Ottawa river to Toronto. Never-

theless, our total expenses for 1936 were approximately $21,250,334.12, while last year they were $26,243,-423.51.

OPERATION COST LOWERED

It should surely interest the people of this province to know that we have operated Hydro this year, 1936, at a cost of $4,993,089.39 less than it cost in 1935. And do not forget that the cost of purchased power had the contracts not been cancelled would have been nearly two million dollars greater in 1936 than it was in 1935. It seems to me that a saving of approximately five million dollars in a single year is worthy of preservation by every lawful means within the power of this Legislature.

REVENUE HAS INCREASED

Our total revenue this year was $24,368,511.25, while last year it was $23,292,490.97.

This is a revenue increase of $1,-076,020.28. This increase in revenue is not as much the result of an increase in load as it is the result of the elimination of unreasonably low prices for a substantial portion of the power sold, and the transfer of sales from secondary to primary as a result of the Commission's more business-like policies.

OPERATION NOW SHOWS A SURPLUS

The net result of this decrease in expense and increase in revenue is that last year we had a deficit of $2,950,932.54, while this year we have a surplus of approximately $3,118,177.13.

Am I not justified in an expression of satisfaction, and perhaps even in a note of triumph, when I tell you that the average deficit of the last four years of the Niagara system was $3,130,488 per year, and I now announce that the surplus for the year just closed is over $3,000,000—an improvement this year over the average of the previous four years of approximately $6,250,000. The deficit of 1935 was $2,950,932.54, so that our improvement over last year was $6,069,109.67.

The betterment of 1936 over 1935 is not, however, a complete statement of the case. The cost of power from the Eastern companies has risen from year to year as the deliveries of power increased. In 1935 we paid $7,936,892.70. In 1936 we would have paid $9,517,500, an addition of $1,580,600. Our deficit in 1935 was $2,950,932.54. The deficit in 1936 would have been $3,575,417. That is to say, we improved our position this year over what it would have been this year had the contracts continued, by $6,693,534.

ENCOURAGING PROSPECTS FOR 1937

Now let me turn to the figures for the current year of 1937. Unless something extraordinary happens during the balance of this winter, we have passed our peak with a total of 180,000 horsepower purchased from the Gatineau and the Maclaren Companies. Our cost of eastern purchased power for the year 1937 will therefore be $2,705,972.18, instead of what would have been the price had the contracts not been cancelled, of $10,965,000. That is to say, in 1937, the difference between what we will pay and what we would have paid is $8,259,000. We have

increased for this year the amount of power purchased by 40,000 horsepower taken from the Gatineau Company. The increase is, of course, the result of increased load, and will be reflected in increased revenue. Should, therefore, our rates at which we sell power remain the same throughout 1937, our surplus would at least be as great as that of 1936, that is to say, substantially more than $3,000,000.

Rate Reductions Were Announced

Under these circumstances the Commission has felt justified in acting in accordance with the announced policy of this Government and of the Hydro Commission, of passing on to the consumer with all reasonable promptitude, the tangible results of our Hydro betterment. Accordingly, in September last, the Commission announced a reduction of $2.50 per horsepower interim charges to the cost municipalities.

To properly appreciate the significance of this announcement, one must bear in mind the circumstances under which it is made. The actual charges by the Provincial Commission as against the municipalities of the Niagara system during the past ten years has not varied greatly. Rates in each municipality are adjusted to cost, so that they lack uniformity, but the true situation may be exhibited if one takes an average of the charges to all municipalities. The lowest average charge in any one year during the past ten years to the municipalities was in 1929 when it was $25.39 per horsepower, and the highest average charge in any one year during the past ten years was that of 1933 when it was $28.16 per horsepower. There is no very great variation between this minimum and this maximum, but the comparative uniformity has been secured at the cost of the Provincial Hydro's reserves, and in some instances and to some extent, notably in the city of Toronto, at the cost of the municipal stabilization account. For instance, during the last four years the city of Toronto drew from its own reserves for the stabilization of rates, the sum of $673,516.53, and I have already stated how the Provincial contingency reserve has been depleted from the sum of $14,631,725 as it stood at one time, to the sum of $3,780,000 as it stood at the first of the year 1936—a reduction which has proceeded at an average of over $3,000,000 per year.

Reserves Again Provided for

During the four years from 1932 to 1935, the Provincial Hydro charged the municipalities of the Niagara system an average of $27.62 per horsepower, but the average cost during that period was $32.85 per horsepower, so that the Provincial Commission made an average loss of $5.23 on every horsepower which it sold during the four year period in question. There must come an end at some time to business of that character. The evil day of increased power charges might have been staved off for a short time by some other method of questionable finance, but the inexorable facts were staring us in the face of annual deficits and depleted reserves, and a very much

greater loss had the contracts for purchased power been completely carried out. When, therefore, I state that a reduction in interim rate has been announced of $2.50 per horsepower, it must be borne in mind that the reduction is over and above an average loss on power previously sold, of $5.23 per horsepower. But even this is not all, for the reduction announced is sufficiently conservative that according to the Commission's accountants, a balance will remain to the credit of the Commission at the end of the year 1937, sufficient to add to its reserves at least $1,000,000 in addition to the usual sinking fund and renewals provisions. One million dollars is the equivalent of approximately $1.50 per horsepower on the total sales of the Provincial Commission to the municipalities.

So that the actual betterment is the sum of these three:

Abolition of annual deficits	$5.23	per h.p.
Reduction in interim rates	2.50	" "
Additional reserves accumulated	1.50	" "
TOTAL	$9.23	" "

That is to say, our policy, as applied to the management of Hydro is better than former years, during 1937, by $9.23 per horsepower.

A Saving of Five Millions

The power consumption of the municipalities of the Niagara district in 1936 was approximately 663,000 horsepower—a betterment of $9.23 per horsepower is the equivalent of a gift to the municipalities of $5,991,000 for this one year. Five million dollars is the interest at 2½ per cent., which is approximately the rate at which Hydro is now borrowing money, on $200,000,000. There are over 500,000 Hydro customers in the Niagara district. That is to say, a betterment in Hydro rates of $9.23 per horsepower to the Hydro municipalities is the equivalent, when capitalized, of an interest-bearing security at 2.5 per cent. per annum, of $400 face value, to every Hydro customer in the Niagara district.

One is reminded of Oliver Cromwell's words in his dispatch to the Council of State following the battle of Dunbar:

"If there be anyone that makes many poor to make a few rich, this suits not a commonwealth."

Hydro Management a Local Problem

It must never be forgotten that the success or failure of Provincial Hydro management is not a mere theory of government, but is rather essentially a matter of service and of cost to the whole body of our citizens. The Provincial Commission has nothing to gain but good-will as the reward of its economies, its wisdom and its courage, and it has nothing to lose beyond popular favour by its incompetence or insufficiency. Provincial Hydro works on a cost basis, and its success is reflected in lower power prices to the municipalities, and its failures are reflected in depleted services and increased power and lighting bills to the consumers. The management of Provincial Hydro is accordingly a local and municipal problem, and

perhaps the true situation may be best brought home to the people of this province if I illustrate in a few concrete and specific examples the effect of the general figures I have given you. Let me refer first to the city of Toronto.

Cancellation Abolishes Toronto Deficit

I select Toronto because it is the largest of all our Hydro municipalities. The municipal portion of the Niagara system has fixed assets of $78,879,000. Included in this figure are the fixed assets of the city of Toronto amounting to $43,582,000. Toronto's capital investment is between 50 per cent. and 60 per cent. of the entire investment of all the municipalities within the Niagara system. For the calendar year of 1935 Toronto collected from its consumers for electrical energy, the sum of $12,738,000, while the total revenue of the remaining 172 municipal commissions of the Niagara system was $14,342,000. The Toronto Commission gave domestic, commercial and power service to 186,222 customers. The $3,000,000 average deficit charged during the past four years to the Commission's obsolescence and contingency fund has not been the only loss occasioned. During this same period the city of Toronto drew from its own reserves, to meet the Commission's increased power charges, the sum of $673,516.53. The cancellation of the power contracts has abolished the deficit in the Provincial system, and it has also abolished the deficit in the Toronto system.

Toronto Makes Huge Savings

Due to the $2.50 reduction, the charge to Toronto this year will be $23.60 per horsepower, which will result in an estimated saving in power costs to the city of Toronto of $710,000 in 1937, and I am glad to observe that the Toronto Commission has co-operated with the Provincial Commission in passing this saving on to the light and power users of the city of Toronto. With their cooperation, the saving to the customers of the Toronto system, due to the reduced rates, will this year be approximately $735,000. But what would have been the situation had the contracts not been cancelled? In that event the cost of power to Toronto in 1937 would not have been $23.60 per horsepower, but rather $31.99 per horsepower, and instead of a saving of $710,000 Toronto would have been subject to an additional power cost of $1,672,634. In other words the difference between cancellation and non-cancellation to the city of Toronto for 1937 is $2,382,600.

Other Municipal Utilities Show Savings

The charge per horsepower in Hamilton in 1936 was $24.50. The interim rate for 1937 is $22.00 and the saving to Hamilton for that year is $248,800 and Hamilton is better off in a twelve-month as a result of our policies by $852,000.

The charge per horsepower in London in 1936 was $27.00. In 1937 the interim rate is $24.50 per horsepower, a saving of $82,000 and London is better off in a twelve-month as a result of our policies by $265,000.

The charge per horsepower in St. Thomas in 1936 was $28.00. In 1937 the interim rate is $25.50 per horsepower, a saving of $17,600, and St. Thomas is better off in a twelvemonth as a result of our policies by $56,000.

The charge per horsepower in Kitchener in 1936 was $27.00. In 1937 the interim rate is $24.50 per horsepower, a saving of $45,000, and Kitchener is better off in a twelvemonth as a result of our policies by $148,000.

And so I might go on, to every municipality, from the smallest to the greatest, from the poorest to the richest, in the entire Niagara system. This is not a matter of party politics. It is one of sound principle, efficient management, good service, and actual money in reduced costs of living and of industry.

Commission Has Ample Power Reserves

Not only is there no power shortage this year, but we have passed this winter's peak with 120,000 horsepower in reserve and unused.

An outstanding example of insincerity is the recent attempt to represent the cutting off of at-will and interruptible power during this winter's peak demand, as evidence of a power shortage. In former times when they purchased vast quantities of power, far in excess of what could be consumed, they made an effort to run up the peak in order to prove that the power was needed. Since this Commission has purchased and paid for only such power as is actually required, it has been the practice, in accordance with common sense and business prudence, to hold down the peak. In view of the fact that every horsepower consumed during the dark days of November and December in each year must be paid for during the entire year, the Commission has entered into a number of contracts in which special rates are allowed, in return for the undertaking from the consumers to restrict their consumption during these periods of heavy demand. At-will and interruptible power is sold on this specific understanding. In order to make some use of excess power during those periods of the year when the Commission's supplies necessarily exceed the requirements of its firm customers, power is sold for the generation of steam, and for metallurgical and chemical manufacture. Now these plants run day and night, and their consumption of power is heavy, while the period during which they are off the lines is inconsiderable. They restrict their consumption between the hours of 4.30 and 7 o'clock in the afternoon, as required by the Commission, and for periods seldom exceeding two hours on any one day—a small portion of the 24-hour service rendered.

No Power Shortage

For many years the city of Toronto has purchased its power on a somewhat similar basis to that now enjoyed by the Provincial Hydro, and as do all other municipalities in the Province—on monthly peak basis. That is to say, they pay during the entire month for the power used during that 20 minutes of highest demand, which may occur at any time throughout the month. It is to

their interest, therefore, to hold down the peak, and they accomplish this by a skilful distribution of loads, and by inducing customers to stay off the lines when the flow of energy appears to be greatest. This practice is well-known to everyone familiar with the electrical enterprise, and any attempt to use the practice as proof of a power shortage crisis is the height of folly or of deception.

There has been no power shortage either in municipal or provincial systems during this past winter or at any time for many years in this province, and the attempt to dupe the reading public by such errant nonsense or insincerity should be resented by those who view the Hydro problem as one of public importance.

Previous Calculations Proven Correct

When I spoke in previous years of the power requirements of the Niagara system, I was necessarily dependent upon calculations, for at that time we had more power than we knew what to do with, but today, when the system is only taking that which it requires, I speak from experience and from the certain knowledge of indisputable fact. Ten years after the signing of the first purchase contract with the Gatineau Power Company we passed the peak of the fiscal year 1936 with 140,000 horsepower only of the 260,000 horsepower then purchased, and we have passed the 1937 peak demand with 180,000 horsepower from the east out of the 731,000 horsepower purchased, which was bought on the understanding, that it would be paid for whether used or unused.

Not only so, but we have also in reserve from the Gatineau Company, 33,000 horsepower of immediate standby at $10.00 per horsepower, and a general reserve of 87,000 horsepower at $1.75 per horsepower, or a total reserve of 120,000 horsepower. The Niagara load reached its highest all-time peak in December of 1929.

In 1929 it was	969,123 h.p.
In 1930 it decreased to	902,392 "
In 1931 it was	828,200 "
In 1932 it was	881,746 "
In 1933 it was	879,893 "
In 1934 it was	901,877 "
In 1935 it was	932,708 "
and	
In 1936 it was	1,005,630 "

Growth in Primary Demand Offset by Reduction in Secondary

It will therefore be observed that the primary peak of 1929 was not equalled or exceeded until the fiscal year that has just closed of 1936, and then by only 36,507 horsepower. The growth last year, 1936 over 1935, was considerable, amounting to 72,922 horsepower, but it must not be overlooked that a large proportion of the manufacturing enterprises of the province are running to capacity, and many are working over-time. There is still a percentage of unemployment, but nevertheless, industry at the moment is going ahead at considerable pressure.

Moreover the growth in the primary demand is offset by a reduction in the secondary demand. The total primary and secondary has actually decreased. In 1935 it was 1,052,815

horsepower, while in 1936 it was 1,028,150 horsepower, a reduction of 24,665 horsepower. This is due to a reduction in the amount of the power sold for steam generation. The outstanding fact is that we passed this winter's peak with only 40,000 horsepower additional supplied.

Ample Provision for Expected Load Increase

I confidently expect some growth in the next winter's peak load as a result in part to our reduction in power prices but we have actually in reserve as against that eventuality, 120,000 horsepower immediately available, and the problem of how much power to hold in reserve is one of business judgment and not of political partisanship, and any attempt to unload Quebec power in the interests of private generating concerns at the cost of the power-users by scaremongering methods or by political manoeuvring is unpatriotic and reprehensible in the highest degree.

The constant propaganda of an impending power shortage has no doubt raised the question in many minds as to the sufficiency of the Commission's reserves and the adequacy of its plans to meet the growth in electrical demand which is possible and even likely. To them I say, be not disturbed. The shortage bogey is raised by the enemies of Hydro for the purpose of embarrassing the Government in the carrying out of its program for the utilization of this province's own power resources. The time has not yet arrived for an announcement of the Commission's plans, and I for one refuse to be stampeded by those who are obviously fighting the battle of the power barons, and who have proven themselves the enemies of Hydro and of public ownership. Let me tell you some facts and draw your own conclusions.

Ogoki and Little Long Lac Surveyed

This summer we withdrew from staking or location the territory which might be affected by a change in water levels by a diversion of the Ogoki River, and we completed the surveys preliminary to the actual calling of tenders. The Ogoki water is estimated at 4,000 cubic feet per second, and if passed through the Queenston plant would develop an estimated 120,000 horsepower.

Preliminary surveys are already in progress with a view of diverting the waters of Little Long Lac from the northern watershed into Lake Superior. The flow is estimated at 1,200 cubic feet per second and if used at Decew Falls would develop 30,000 horsepower.

Water Rentals Reduced

We are just completing with the Hon. C. D. Howe, Minister of Transport, details of an agreement with respect to the use of water from the Welland Canal at Decew Falls. The Dominion's annual charges are cut in two. They were formerly $150.00 per cubic foot per second. In future they will be $75.00 per cubic foot per second for water delivered to the Commission's weirs at Allanburg, in accordance with treaty rights as they now exist. We have been taking 1,000 cubic feet per second,

and this amount will be increased immediately to 1,100 cubic feet per second and further increases are expected as water now used for other purposes is released. There is a prospective increase in capacity at the Decew Falls plant on this account of some 20,000 horsepower.

Those of you who care to speculate may find significance in the fact that the Dominion has further agreed to carry in the Welland Canal to its capacity without injury to navigation, other water which may be made available at $50.00 per cubic foot per second.

A cubic foot per second is the equivalent of approximately 25 horsepower at Decew Falls at 100 per cent. load factor. Gibson Lake on the escarpment, above the Decew Falls plant affords unique facilities for the storage of water for use during peak hours. A cubic foot is the equivalent of 100 horsepower at 25 per cent. load factor. Let those with imagination speculate, on what the Commission may be able to accomplish with, say, 1,000 cubic feet per second delivered through the Welland Canal at Allanburg.

Other Possibilities Considered

Surveys were completed this summer preparatory to the development of the Madawaska—the estimated capacity of which is 85,000 horsepower.

We have just completed an agreement with the Dominion Government by which the Commission has secured completed control of the power resources of the Trent valley, other than that already alienated to private parties, and this summer we purchased three plants of the Canada Cement Company for $225,000 giving us added capacity of 4,200 horsepower, estimated on a commercial basis. The rental of the entire river is reduced from $89,880 to $75,000 per year, and the arrangement will make possible a much more effective use of the river flow.

Surveys were completed this summer for a development of 10,000 horsepower on the Muskosh River which flows from Lake Muskoka to the Georgian Bay. This new power will replace the 2,000 horsepower purchased from Orillia this summer, and will release the 7,000 horsepower which is delivered from the Niagara system through a frequency changer at Hanover.

Future Power Sources to be Commission Owned

I mentioned these details of things actually accomplished in order to indicate the direction in which the wind is blowing. It is not blowing eastward towards Beauharnois, or towards any other privately owned source of power. It is blowing in each instance towards public ownership, towards propositions, the cost of which is so low as to make a joke of $15.00 per horsepower purchases.

And do not forget that there are many thousands of horsepower still available from the mighty flow of the Niagara without injury to the river's scenic beauty.

Do not forget that the Commission owns the Ontario side of the Carrillon power on the Ottawa River with a capacity of 200,000 horsepower.

Do not forget that the DesJoachim and associated powers on the upper

Ottawa are within 100 miles of the lines of the Georgian Bay system. The estimated capacity is 400,000 horsepower, and the cost of development is in the neighbourhood of $6.00 per horsepower.

Do not forget that Ontario's share of the undeveloped horsepower on the St Lawrence is 1,000,000 horsepower. It is not possible of immediate development, but it has an interest in its far future.

The Niagara system is surrounded with undeveloped power. The problem is not in finding sources of supply, but rather in choosing the source which lends itself to the cheapest and most advantageous development—in selecting the proper moment in which to proceed and in effectively carrying through to completion. You will know quite clearly some day why we limit our purchase contracts to ten-year periods.

The time is not yet ripe for the announcement of the Commission's plans, nor is there any obligation to reveal them to those whose only object would be to block them. To those in the House and in the country who are in favour of public ownership and the development of our own resources, and who feel that we are on the right track, I say, have patience. Give us your confidence and your ancient ambition for a wonderful Hydro will come true.

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EASTERN ONTARIO SYSTEM

There is something quite remarkable about the results achieved in the Eastern Ontario system during the year that has just closed.

Drastic reductions have been made in the price of power charged to the municipalities, amounting in the gross to the sum of $133,200.

Increased Revenue with Decreased Expense

The system's load and its gross revenue have both increased, but the expense of doing business has not increased in proportion, so that the reduction of $133,200 in the price of power has been absorbed and an operating surplus approximately equal to that of last year has been maintained.

The peak load for primary power in December, 1934, was 96,783 horsepower. In the same month of 1935 it was 107,185 horsepower, an increase of 10,402 horsepower or 10.74 per cent.

In 1936 the December peak load was 119,200 horsepower, an increase of 12,015 horsepower or 11.2 per cent. It is to be noted with satisfaction that the 1936 increase is the result of a general advance throughout the system, involving practically every town and rural power district. It is a healthy, normal growth in practically all municipalities of the system. This type of growth is the most satisfactory, because it is apparently the most permanent.

System Shows Surplus

The gross revenue including rural shows a corresponding increase.

In 1933 the gross revenue including rural was	$2,920,450.19
In 1934 it was	3,084,008.59
In 1935 it was	3,182,930.67
In 1936 it was	3,322,197.80

The growth in revenue in 1935 was $98,922. The growth in 1936 was $139,249.

Notwithstanding this growth in revenue there has been, during the operations of the present Commission, a satisfactory relative decrease in expenses of the system's operation, interest, and reserves included. In 1933 these expenses were $2,145,868.73.

In 1934 they were	$2,140,436.77
In 1935 they were	2,089,411.13
In 1936 they were	2,216,359.97

This is a growth in cost of operation of $70,491.24, which is to be added to the cut in price of $133,200, an amount of $203,691 to be made up. But the offsetting growth in revenue was $139,269 and the surplus of $236,597.42 is only $7,267 less than last year.

Reduction in Charges to the Municipalities

The reductions in the cost of power to the municipalities, amounting, during the year, to $133,200 is a very considerable figure, as applied to the Eastern system where the loads are very much less than in the Niagara system. It amounts to approximately $2.50 per horsepower. This decrease in power costs is reflected in the bills of every municipality. Belleville, for instance, has a cut in rates of $25,900.

Bowmanville	$12,100
Carleton Place	3,600
Cobourg	9,500
Lindsay	8,300
Napanee	6,000
Oshawa	19,300
Perth	4,400
Peterborough	11,600
Port Hope	$ 8,800
Smiths Falls	6,000
Trenton	8,700
Whitby	2,600

And here may I pass a compliment to the city of Kingston. This municipality operates under contract with the Hydro Commission and not on a cost basis, and the local commission has recently reduced rates to its customers by $34,500 per year.

Refunds Made to Consumers

In addition to reduced rates, the customers of the Eastern system for this year received refunds from their local commissions of $139,000. So the year has been one of good cheer, to the electric power and light customers of the East, and they have further satisfaction in the fact that notwithstanding the financial benefits mentioned, the Provincial Hydro Commission this year boasts a surplus of $236,597.42.

Provision for Future Satisfactory

The people of the Eastern district have also grounds for satisfaction in the policy adopted and the progress accomplished during the past year with reference to their power supply. The House is already aware of the change in the contracts of the Eastern system with the Gatineau Power Company. The price being paid to that company for power purchased is $12.50 per horsepower, and the Commission still has a reserve with the Gatineau Company of 9,000 horsepower immediate standby at $10.00 per horsepower, and 9,000 horsepower of general reserve at $1.75 per horsepower, or 18,000 horsepower reserve in all.

Water Rentals Lowered

During the year, however, the Commission has held in mind its policy of public ownership of the sources of supply as well as the distribution of power, and I have the greatest satisfaction in announcing an agreement in course of completion with the Dominion Government, which not only reduces the Dominion's charges in connection with water at various power sites on the Trent waterway from $89,880 to $75,000 per year, but in addition gives to the Commission the virtual control of the entire river. Navigation on the Trent waterway is now recognized to be of secondary public importance, and it has been agreed that the Commission may lower the river when required to keep up a supply of power from eight feet four inches above the sills, to six feet three inches above the sills. This will considerably improve the usability of the Trent river for power purposes, and the Dominion Government has further agreed to co-operate with the Hydro Commission to bring about the most advantageous use of the Trent watershed for both navigation and power purposes.

Advantageous Purchase Made

With this satisfactory arrangement in hand, the Commission has recently purchased three plants, the property of the Canada Cement Company near Lakefield. The installed capacity of the three plants is 4,200 horsepower, and its available capacity for commercial purposes is estimated at 4,000 horsepower. A recent physical valuation of these plants showed a replacement cost of $713,000, and a present physical value of $509,500. The Commission has purchased the three plants for the sum of $225,000 and allowing $30,000 as the cost of rehabilitation and expenses, it is estimated that the power from these plants can be delivered to our high tension transmission system at Peterborough at a cost of $9.81 per horsepower. With head office and all other administrative costs included, the total cost would be $11.33 per horsepower. It is to be recollected that the Commission purchases power from the Gatineau Company delivered at the inter-provincial boundary at $12.50 per horsepower, and that its estimated cost delivered at Kingston is $17.60.

The purchase of the plants has therefore three outstanding advantages. It is in the direction of public ownership—it provides 4,000 additional horsepower at favourable rates and it facilitates markedly the control of the water flow through these and other plants on the same river.

Mississippi and Madawaska Survey Completed

It will also no doubt be a great satisfaction to the people of the Eastern district to know that the Commission has this year completed its surveys of the Mississippi and Madawaska rivers, with a view to developing the at present unused power on the Madawaska river. It will be remembered that the two plants, one at Galetta and the other at Calabogie having a total installed capacity of 6,500 horsepower, together with undeveloped capacity on the Madawaska river of approximately 85,000 horsepower had been purchased by the Commission for $1,800,000. Up until last year, 1936, these

two plants carried a load of less than 2,000 horsepower as their available outlet was a small local system in the neighbourhood, and they had no electrical connection with the balance of the Eastern system. In 1935 the Commission built a 33,000 volt transmission line from Galetta to Smiths Falls at a cost of approximately $120,000 and made available to the Eastern system additional resources of approximately 4,000 horsepower, at an additional capital outlay of approximately only $30.00 per horsepower. The low cost of this additional energy is reflected in the favourable financial balance to which I have already referred.

Madawaska Development Significant

The development of the additional power on the Madawaska river will have the greatest significance in the distribution of power in the Eastern district as the experience of last summer amply demonstrates. Gatineau Power comes south, over a line to Kingston. The line from Kingston east to Belleville is now loaded approximately to capacity thus making it impossible without heavy capital expenditure to bring additional Gatineau Power into the Trent valley. The flow of water in the Trent river is subject to seasonal variation, and this last summer was exceptionally low. The normal generating capacity of the Commission's Trent valley power plants is 53,000 horsepower requiring a flow of 1,200 cubic feet a second. In the summer of 1936 the flow diminished to less than 500 cubic feet a second, reducing the capacity of the plants even for peak requirements to approximately 25,000 horsepower, and to an average amount of between 9,000 and 10,000 horsepower.

Frequency Changer Averted Disaster

There was a deficiency of power in the electrical system of the Trent valley of some 27,000 horsepower. This left the district with a power shortage of at least 10,000 horsepower over and above the maximum amount that could be transmitted over the line from Kingston to Belleville, and the locality was face to face with the prospect of darkened streets and shut-down industry, had it not been for the facilities afforded by the new frequency changer at Chats Falls.

There are three lines in the high tension transmission system from Chats Falls to Toronto and the flow of electrical energy was at the time sufficiently light to be confined to two lines only, leaving the third available for emergency purposes. A connection was made between the third Gatineau line and the Eastern system in the neighbourhood of Peterborough, and a supply of 60 cycle power was obtained through the frequency changer from one of the 25 cycle units of Chats Falls until the crisis was passed and the disaster averted.

Frequency Changer Long Recommended

It is true that the immediate purpose of the frequency changer was to protect the Eastern district from the threat of reprisals by the power interests of Quebec but the connecting of the two systems by change of frequency at Chats Falls had long been advocated by the system's engineers as a matter of operating efficiency,

and the experience of the last summer is proof of the wisdom of that advice.

The development of power on the Madawaska river and the Mississippi will round out the Eastern system in two ways because its point of delivery will be in the vicinity of Belleville via a line running southwest from the vicinity of Chats Falls through the centre of the district, midway between the two existing high power lines from Chats Falls to Toronto and from Ottawa to Kingston. There will thus be made available to the entire district from Port Hope to Kingston and of all the towns in the Trent valley the power not only of the Madawaska and the Mississippi, but also that available through the frequency changer. When this is accomplished the Eastern district will operate as a completely connected unit with highest efficiency drawing its power from a large number of interconnected sources.

* * * *

GEORGIAN BAY SYSTEM

The outstanding features of the financial year in the Georgian Bay system is a reduction in rates amounting in gross to $45,290, accompanied by a refund to consumers of $35,140. This comfortable news so far as the consumer is concerned, is accompanied by the maintaining of a favourable balance. The surplus of 1934 was $86,333. That of 1935 was $95,423, and the surplus of this year 1936 is $82,298, so that the system is in sound financial condition.

Demand is Increasing

A steady growth in the system's maximum peak over the last few years, however, presents a problem so far as future supplies of power is concerned. The 20-minute maximum peak, which occurred in July or August each year, over the last few years has been as follows:

1933	26,606 h.p.
1934	27,859 "
1935	29,229 "
1936	29,839 "

This is a growth, during the past four years of 3,200 horsepower.

Power Purchased at Satisfactory Rates

To meet this growing demand the Commission this year purchased from the town of Orillia, approximately 2,000 horsepower, made available to that town's supply by its recent development at Minden. The purchase is on a kilowatt-hour basis, that is to say, the Commission buys energy as it is required, and pays for it as it is received. This is a very advantageous form of purchase as it has carried the system over its peak on a total charge of $11,688.11. This compares very favourably with the prices paid to the Eastern Power Companies by the Niagara system which at $15.00 per horsepower would be $300,000 per year.

The Georgian Bay system also purchases on the same favourable basis between 6,000 and 7,000 horsepower from the Niagara system, taking delivery through a frequency changer at Hanover.

The Georgian Bay system has fortunately escaped the complications of power purchased from private companies. It has eleven publicly-owned generating plants, with a normal operating capacity of 26,100 horsepower,

but it is to be noted that the season's maximum demand occurs in July and August, which is the period of low water. The result is that the plants are operated to the full capacity of the water available, and the purchases from Orillia and the Niagara system are required to supply the deficiency. The time has therefore arrived for the consideration of a development of one of the district's available power sites. These are fortunately to be found conveniently located on the Muskosh river upon which there is a usable fall of 158 feet, permitting of a total installation of 40,000 horsepower—an amount sufficient to more than double the system's present supply, and to satisfy its requirements for a considerable number of years.

THE MUSKOSH TO BE DEVELOPED

There are five powers on the Muskosh river. The first is at Ragged rapids, some four miles down stream from the outlet of lake Muskoka at Bala. This development will produce some 10,000 horsepower, and is the one selected by the engineers for immediate utilization. Another power is located at Bala which will be the next to be developed, as it gives control of the flow of water from lake Muskoka. The others are at Big Eddy, Sandy Grey, and Go Home bay.

If the development of the Ragged rapids is commenced this spring it can be brought into the system's supply by the summer of 1938. Its cost would be in the neighbourhood of $1,700,000, but the added carrying charges and operating expenses would be immediately offset by the discontinuance of purchased power from Orillia and the Niagara system, so that the carrying charges on the capital outlay would be offset by corresponding savings and probable increase in the system's load without any appreciable disturbance in costs to the municipalities or rates to the consumers.

* * * *

THUNDER BAY SYSTEM

One of the Commission's outstanding achievements during the year 1936 is in the Thunder Bay system, which comprises the cities of Port Arthur and Fort William, adjacent rural and mining districts, and the village of Nipigon. The Commission draws its supplies from two plants—one at Cameron Falls and the other at Alexander Landing on the Nipigon river, with a total available capacity of 123,500 horsepower. Due to the excess of supply over the system's demand, the Commission during past years sold a portion of its power at prices as low as $4 per horsepower for use in the generation of steam. The consequence was a long series of deficits aggregating, up to the year 1935, some $654,500, which was met in deductions from the system's reserves and in 13th bills to the two leading municipalities.

RATES HAVE BEEN REDUCED

Last year, 1935, I had the satisfaction of announcing to this House the first surplus in many years, amounting to $2,770, and I also stated that the Commission had under consideration the reduction in the price for firm power charged to the important pulp and paper mills situated in the Twin Cities. This year that reduction has taken place. The former price of from $20.00 to $21.50 per horsepower for high-tension firm power has been re-

duced to $18.00 per horsepower. The reduction has been followed by the expected result of increased consumption. Loads have increased in the paper mills, in the towns, and in the mines, to the extent that the Commission's revenue has advanced by $129,700 in 1936 over 1935. The Commission has also made substantial savings in the reduction of interest charges, amounting to $29,500, and I am accordingly in a position to announce a surplus this year of $146,100. This surplus is without provision for the usual contingency and obsolescence reserve which has not been maintained in this system for a number of years.

UNDEVELOPED POWER AVAILABLE

In Hydro management as in life generally, however, success brings its responsibilities. The available capacity of the Commission's plants is, as I have said, 123,000 horsepower, and the system's December primary peak of this year was 83,090 horsepower—an increase of 12,835 horsepower over last year, or 18.3 per cent. and the load is rapidly growing. The margin of capacity available is only 40,000 horsepower, and this is being completely used for steam purposes, though at low prices. The Commission is, therefore, facing the necessity for further development of the Nipigon river powers. This, fortunately, can be very cheaply accomplished by the installation of additional units at both Cameron Falls and Alexander Landing, where space has been provided for such expansion, provided that further water can be obtained. This will be available from the Ogoki River diversion, giving an added capacity at the mere cost of the additional electrical equipment, of 35,000 horsepower, and the transmission lines already in existence are sufficient to carry the added load. The cost of the Ogoki diversion is estimated at $3,000,000, and the cost of the proposed extension at Cameron Falls and Alexander Landing is estimated at $2,000,000. It is interesting to note that this development alone, so soon as the power is required, would justify the Ogoki diversion, for on the basis of 35,000 horsepower, the aggregate capital cost would be in the neighbourhood of only $143 per horsepower, though, of course, there is no thought of charging the entire Ogoki costs to the Thunder Bay system.

* * * *

MANITOULIN RURAL POWER DISTRICT

Manitoulin is the baby system of the Commission, both in age and in stature. It was founded in 1933 and for the portion of the year in which the system was in operation, it had a deficit of $1,383. For the full year of 1934 it had a deficit of $2,023, and last year, owing to a reduction in expenses of over $1,000 together with some increases in revenue, it had a deficit of only $626. The average demand of the system last year for the supply of 176 customers was 101 horsepower. This year it has added customers, and reports an average load of 124 horsepower, an increase of 22.8 per cent. and a surplus of $715, a betterment of $1,341 over 1935.

In my last year's report I predicted a surplus this year, and this

happy condition has been accomplished by an increase in revenue of 5.34 per cent. and a decrease in expenses of 11.73 per cent.

* * * *

RURAL POWER DISTRICTS

In no portion of its Hydro management is this government more vitally interested than in the supply of electrical services in rural communities. Automatic machinery and bright lights are in keeping with the progress of this age, while the drudgery and ineffectiveness of manual labour, and dark and dismal homes rightfully belong to the barbarities of the past. No money is better used than that expended in bringing the enlightenment, comfort and efficiency of modern electrical services to our farms and rural homes. Nineteen-thirty-six has been a banner year in this regard. This year the Commission has added to the systems and the rural power districts, 810 miles of primary line constructed and under construction at a cost of $2,154,000, of which the province has contributed by way of bonus $1,074,000, and it has added 5,790 customers to those already served. Under this constant and energetic expansion, rural hydro has developed into a great system.

There are 10,787 miles of primary lines in the rural power districts, giving service to 73,592 customers. The capital investment in this system is $20,675,000, of which the Provincial Government has contributed by way of bonus, $10,321,000.

The Commission expects during the current year of 1937 to continue its work of new construction at an accelerated rate. Last year, as I have said, we built 810 miles. This year we estimate our construction at over 1,000 miles. We estimated our expenditure last year at something over $2,000,000. This year we anticipate an expenditure of $2,500,000, and we hope to add over 7,000 customers.

REDUCTION MADE IN SERVICE CHARGES

The greatness of this expansion is made possible by very welcome reductions by the Commission in power

NET SERVICE CHARGE IN EFFECT

	Per Month 1935	Per Month 1936	Per Month 1937
Class 3 —Light Farm Service	$2.50	$2.00	$1.00
Class 4 —Medium Farm Service, Single Phase	2.70	2.15	1.61
Class 5 —Medium Farm Service, Three Phase	3.75	3.00	2.25
Class 6A—Heavy Farm Service, Single Phase	4.65	3.70	2.77
Class 6B—Heavy Farm Service, Three Phase	5.30	4.25	3.19
Class 7A—Special Farm Service, Single Phase	6.95	5.55	4.16
Class 7B—Special Farm Service, Three Phase	8.35	6.70	5.02

costs to its rural consumers. Since the Commission took office in the summer of 1934, two major reductions in the net service charge to farmers have been made as set out in the tabulation on page 52.

Of the classes mentioned, No. 3 being the standard farm is by far the most important. Of the 29,600 farm customers, 20,000 are in Class 3. It is interesting, therefore, to note the reductions in net service charge made to this class over a number of years as follows:

	1920	$6.20 per month
June	1, 1921	5.07 per month
Apr.	17, 1924	4.10 per month
Jan.	1, 1930	2.50 per month
Nov.	1, 1935	2.00 per month
Dec.	1, 1936	1.00 per month

The House will appreciate the importance of these figures when I state that the reduction per month in 1936 amounted in gross figures for the year to approximately $225,000, and the further reduction in 1937 is estimated to amount to an additional gross sum of $340,000, or a gross reduction by this Commission of approximately $565,000 a year.

Is it any wonder in the face of these substantial reductions that the Commission hopes this year to add 1,000 miles to its lines and 7,000 new connections to its list of customers. The public benefit of this policy of the Commission can only be imagined; it is beyond calculation.

* * * *

NORTHERN ONTARIO PROPERTIES

It is to be observed that I have now given the salient facts with references to the finances of each one of the five systems of the Commission-owned Provincial Hydro, and that each and every one is in sound financial condition. When the present Commission took office in 1934 three of these systems, the Niagara, Thunder Bay, and Manitoulin were in the red—the combined deficit amounting to $3,032,770.95. Today it is to be noted that in all these three systems that the deficits have been turned into surpluses and the combined surplus of all five systems is as follows:

Niagara	$3,118,177.13
Eastern Ontario	236,597.42
Georgian Bay	82,298.12
Thunder Bay	146,101.07
Manitoulin	718.80
A TOTAL OF	$3,583,892.54

And so, too, I am glad to say that for the first time since the opening of the Abitibi Canyon properties. the Northern Properties this year show a surplus. I treat the Northern Ontario Properties separately from the other Hydro systems due to the fact that the assets are owned by the Government and are operated by the Hydro-Electric Power Commission upon the Government's financial responsibility. The Northern Ontario system is divided into six districts, as follows:

Abitibi; Nipissing; Wahnapitae (Sudbury); Espanola; St. Joseph (Albany River); Patricia (Red Lake).

ABITIBI SHOWS FIRST SURPLUS

In previous addresses I have found it convenient to report those districts other than Abitibi, and then Abitibi. In 1934 the divisions other than

Abitibi showed a surplus over and above cost of operation, maintenance, interest, renewals and obsolescence and contingencies of $140,806.14. In 1935 the surplus on a similar basis was $127,041.67. This year because of continued growth and good management, the surplus is $157,-225.96. Now, turning to the Abitibi district; without provision for obsolescence and contingencies, the actual deficit in 1934 was $478,560.21. The revenue received was little more than 50 per cent. of the expenditure. Thus a surplus of $140,806.14 in the districts other than Abitibi was totally absorbed, and the Northern Ontario Properties as a whole showed a deficit of $337,754.07.

In 1935 the Abitibi deficit was reduced to $271,505.44, which once again absorbed a surplus of the districts other than Abitibi and left a loss over the entire Northern Properties of $144,463.77.

This year, 1936, the districts other than Abitibi show a combined surplus of $157,225.96, and Abitibi itself shows a surplus of $70,997.81, a combined balance to the good of $228,223.77.

These figures require some explanation. The deficit of 1934 was, without the addition of reserves for sinking fund in any of the Northern Properties, Abitibi included. In 1935 sinking fund was accumulated in the districts other than Abitibi, but not in Abitibi. I have given comparable figures for 1936, that is to say, sinking fund is included in the financial balance of the districts other than Abitibi, but not in Abitibi.

In making my report last year, I prognosticated that the Abitibi division would be out of the red for 1936. My prophecy has come true, and I have now to announce that the figures for November just at hand show the system to be paying, and with revenue sufficient to provide for all operating expenses and fixed charges, and a sinking fund as well.

The combined balance in 1936 of all the Northern Ontario districts is short only $41,233.24 of discharging all its operating expenses and fixed charges and providing throughout the usual sinking fund. The Northern load is still growing, and accordingly, I am quite safe in anticipating that in 1939 the system will provide all standard reserves and sinking fund, with a substantial balance remaining.

ABITIBI LOAD SHOWS INCREASE

The growth of the load in the Abitibi district is due to two causes. First, the increase in mining business, and second, the reduced prices at which the Commission is now selling power. When this Commission took office the standard charges for power in this district was $50 per horsepower. On a comparable basis this Commission has been charging $35 per horsepower, and the added service provided and the lower rates charged by the publicly-owned system has contributed in no small measure to the mining development which has taken place. The growth of the Abitibi load has been continuous and very satisfactory.

In 1933 it was .... 16,340 h.p.
In 1934 it was .... 33,512 h.p.
In 1935 it was .... 57,357 h.p.
In 1936 it was .... 75,067 h.p.

That is to say, since 1933 the load has multiplied five times.

Additional Water Supply Considered

The Abitibi plant has an installed capacity of 275,000 horsepower, but it must be pointed out that the mining plants operate day and night and the electric load is on a 24-hour basis. The call on the water supply at the Abitibi plant is, therefore, continuous, and the quantities used are enormous. The load that can be supplied by the plant is limited not by the capacity of its equipment but rather by its water supply, and it is estimated by Hydro's engineers that the demand for firm power will, in the next three years, reach the capacity available from the present flow. This capacity may be increased by the construction of a storage dam on the Frederickhouse river to control the levels of Frederickhouse and Night Hawk lakes—the installation of which was part of the original plan for the canyon development. The construction of this dam would make available an estimated 300,000 acre feet of storage, and increase the dependable flow to 6,200 cubic feet per second, and provide for an additional load of approximately 40,000 horsepower. The cost is estimated in the neighbourhood of $500,000.

FINANCING

Commission's Borrowing Power Improved

The record of sound finance to which I have referred in each of the various divisions of the system under the Commission's control, has strengthened confidence in the Commission's ability to meet its obligations as they fall due. Business men recognize good management in the institutions in which they invest and the result is improved credit and reduced interest charges. No greater compliment has been received by the present Commission than that paid by the investing public of the Dominion. As Hydro's indebtedness has fallen due, it has been refunded at markedly decreased rates, involving in each instance, substantial savings. In January of 1934, the former Provincial Government sold three bond issues in the proceeds of which Hydro shared and they are as follows:

$20,000,000—three-year bonds, at an effective rate of 4.5%
5,000,000—six-year bonds, at an effective rate of 4.6%
15,000,000—fifteen-year bonds, at an effective rate of 4.8%

In 1932 there were three issues as follows:

$ 5,000,000—three-year bonds, at an effective rate of 6.45%
2,000,000—fifteen-year bonds, at an effective rate of 6 %
20,000,000—fifteen-year bonds, at an effective rate of 6.1 %

The lowest rate on any Hydro bond financing, long or short, from 1925 to July, 1934, was 4.4 per cent.

The present Government took office in July of 1934, the very year in which three issues had been sold in the previous January at rates in excess of 4.5 per cent. In December of that same year, 1934, the Hydro made the first issue of its

own bonds, guaranteed by the Provincial Government—$10,000,000 eight-year bonds, at 3.05 per cent.

We followed that on March 1st, 1936, with $15,000,000 of five-year bonds at 2.60 per cent., and we followed that in June of 1936 with $10,000,000 of eight-year bonds at 2.65 per cent. Two million six hundred thousand dollars of the proceeds was used for capital expenditure in the Niagara and other systems and $5,000,000 for capital expenditures in connection with the Northern Ontario properties, and the balance of the $35,000,000 was used for refunding purposes or for the payment off of previous borrowings which had fallen due, and which carried interest at higher rates. The saving to the Commission on this refunding amounts to $744,311 a year. In the face of these striking facts, the criticism that the Commission's credit has been injured by its policies is futile and absurd.

Commission Now Issues Own Bonds

In former years capital expenditures on the part of the Commission were financed by the Government from bonds issued for Hydro purposes. The Commission has changed this policy, and as new capital is required or bonds issued on behalf of the Commission fall due, the Commission issues its own bonds, guaranteed by the Government. In these new issues the Government's credit is affected only indirectly, and is secondary to that of a revenue-producing enterprise of unexcelled security.

In July of 1934, when this Government took office, the Hydro-Electric Power Commission owed to the Government of Ontario the sum of $189,994,133.63. Since that time Hydro has repaid to the Government $4,823,081.98 in sinking fund payments, and by way of retirement of Government bond issues replaced by Hydro, the sum of $33,598,107.71—a total of $38,421,189.69 and has accordingly bettered the debt position of the province by that amount. As this policy continues, Hydro's entire indebtedness will be removed from the provincial statement of indebtedness. The sum of $59,000,000 of the present Hydro indebtedness to the province will be absorbed by the Hydro out of the provincial debt in the next ten years and in time the entire item will disappear.

* * * *

CONCLUSION

The story that I have told is one of steadily increasing public service—of rising revenues in the face of decreasing rates and charges, and sound management resulting in favourable financial balances in every division of the great electrical system under the Commission's management. It is with very genuine satisfaction that the Commission reports the rescue of Hydro from the financial wreck in which we found it, and its rehabilitation upon sound principles of business efficiency and public ownership. The present situation is satisfactory and the future is bright and happy with a reasonable prospect of enlarged operations, increased public service, relatively reduced operating expenses, and lower prices to the consumer.

But I must point out that this brilliant prospect is dependent upon one thing. Hydro must be permitted to retain for her own purposes the revenue which she collects from her customers. She cannot be at once the servant of the people and at the same time the milch cow of the monied interests.

Hydro is worth saving. The Act which you passed in 1935 had that end in view. You declared the Eastern power contracts to be unenforceable, but the judges are divided in opinion as to the constitutionality of that particular legislation. The Bill which I have introduced effects the self-same purpose, but in a different way. In 1935, you said the contracts were unenforceable. In 1937, I ask you to say that any judgment against Hydro based upon these contracts shall be unenforceable. If you approve of the one, you should have no difficulty with the other. This Bill but surmounts some purely technical legal difficulties.

Walter Daykin, Wiarton

Walter Daykin, Superintendent of the Wiarton Public Utilities Commission for the past seven years, died on January 25th, 1937.

Mr. Daykin came from England to Brantford about thirty-five years ago. While in Brantford he was engaged as an electric wireman. After about three years he went to Norwich and entered the employ of the privately-owned electric lighting system; his duties being those of wireman, lineman and power house attendant. When Norwich took over the electric lighting system in 1911, he continued in its employ and in 1912 was made superintendent.

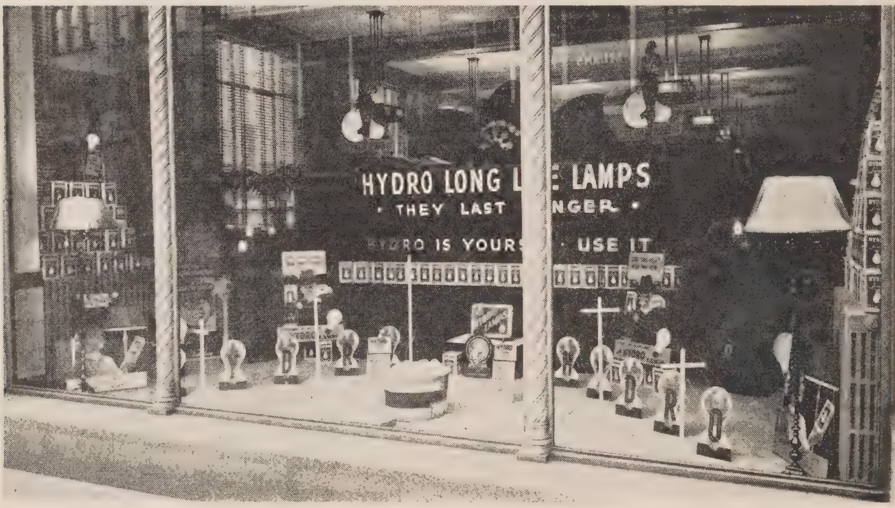
The first Hydro rural line was

Niagara Gorge at O.P. Powerhouse, February 17, 1937

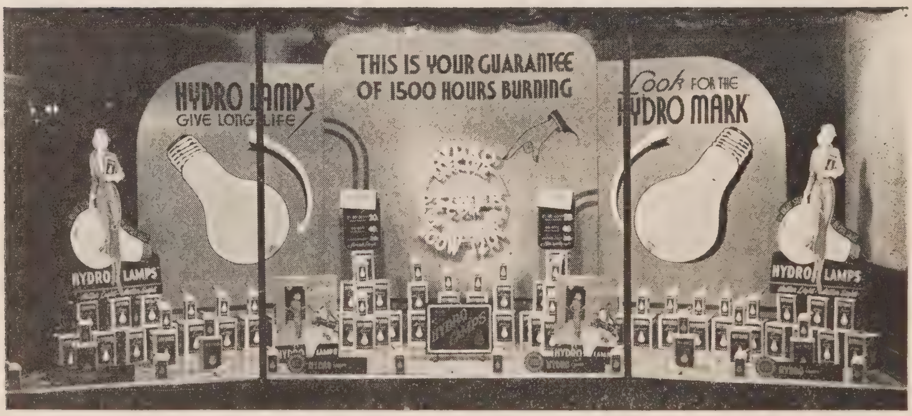
built running out from Norwich, and after it was completed Norwich Public Utilities Commission was given the supervision of its operation, which Mr. Daykin performed in addition to his other regular duties. After twenty-five years in Norwich, he went to Wiarton where he remained until his death.

In the performance of his duties, Mr. Daykin was always very conscientious. Those who worked with him always held for him the highest esteem.

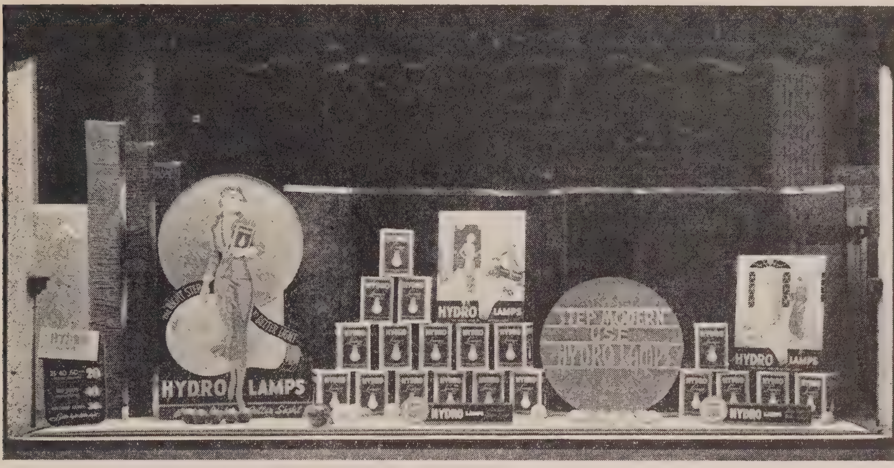
He is survived by his widow and two sons, to whom we extend our sympathy.



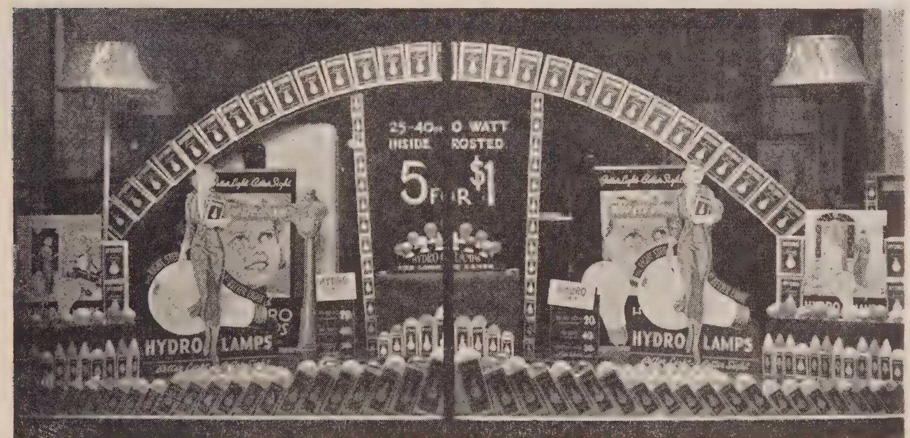
First Prize, Class 2, Kitchener Public Utilities Commission.



Second Prize, Class 2, Belleville Hydro-Electric System.



Tie Third Prize, Class 2, Chatham Public Utilities Commission.



Tie Third Prize, Class 2, Stratford Public Utility Commission.

Hydro Lamp Window Dressing Contest Awards

Class 2

The Class "2" awards in the 1936 Annual Hydro Lamp Window Dressing Contest represent the efforts of those Hydro Shops located in cities of less than 100,000 population.

The same keen sense of rivalry exists among this group as was evident in the previous published group. Some very fine displays have been created by Class "2" entries and they have proved to be real selling windows.

History and Report of Municipal Hydro-Electric Pension and Insurance Plan

THE Municipal Hydro-Electric Pension and Insurance Plan is essentially a co-operative arrangement among the Municipal Hydro-Electric and Public Utility Commissions of the Province to provide pensions, and insurance payable at death, for permanent employees of such utilities.

The need for the establishment of a superannuation plan for Municipal Hydro employees was discussed at a number of conventions of the Ontario Municipal Electric Association, following the establishment in 1923 of the Pension and Insurance Plan for the employees of The Hydro-Electric Power Commission of Ontario. In 1925 the keen interest displayed resulted in the appointment by the Ontario Municipal Electric Association of a Committee to investigate the matter. As a result of this Committee's research, which extended over a period of almost four years, and with the co-operation of The Hydro-Electric Power Commission, a satisfactory plan was evolved.

During the period of research, the Provincial Legislature passed an Act to provide for authorizing pensions and insurance for employees of Municipal Hydro-Electric Systems. This Act was assented to on April 5th, 1927, and is known as "The Power Commission Insurance Act". The Act provides that the Commission may enter into an agreement with any municipal authority or group of municipal authorities, authorizing the Commission to contract with an insurance corporation for insurance for the employees of such municipal authority, and for payment by the municipal authority of the cost of such insurance and of the costs incidental to the administration and operation of the contract. The Act also provides that the Commission may, with the approval of the Lieutenant-Governor-in-Council, enter into an agreement with an insurance corporation for providing such insurance.

The special powers contained in The Power Commission Insurance Act of 1927 were given effect to by The Hydro-Electric Power Commission of Ontario in 1929. Open tenders were invited and a contract was made with three Ontario insurance corporations: the Confederation Life Association; the London Life Insurance Company and the Mutual Life Assurance Company of Canada. This contract enables individual municipal commissions, by an agreement with The Hydro-Electric Power Commission of Ontario, to become members of the Plan on a co-operative basis.

The Plan provides the following benefits to employees of municipal commissions participating:

1. A monthly pension on attaining the age of 65 years, payable during the balance of the employee's lifetime.
2. Insurance payable on the death of an employee to the beneficiary of such employee, whether death occurs before or after retirement.

In order to ensure that the Plan was actuarily sound, the Commission consulted Professor M. A. Mackenzie of the University of Toronto, who did much of the work of drawing up schedules of benefits; of payments by municipal commissions, and of contributions by employees.

From its inception in May, 1929, the number of municipalities entering the Plan has grown steadily. In 1929, twelve municipal commissions were included. During the intervening years, others have been added, until today 48 municipalities throughout the Province are included, and pension and life insurance benefits are enjoyed by more than 2,050 employees of the municipal commissions. As a further indication of the magnitude of the Plan, it may be noted that the life insurance coverage provided exceeds $4,300,000, and there are being purchased monthly retirement incomes aggregating more than $144,000.

Under a plan of this character, the first benefits to come into operation are those resulting from the payment of life insurance following the death of employees. Although the Plan has only been in operation a little over seven years, no less than 94 death claims have been met, involving the payment to beneficiaries of some $192,000.

The vision and wisdom of those connected with the Hydro movement who conceived the possibility of such a plan and brought it to a working basis, has been fully justified. The provision of the money in connection with the death claims that have been paid already has, in many cases, relieved distressful conditions. The smallness of the margin between wages and necessary expenditures makes it difficult for the working man to make provision for his old age or possible death apart from some such co-operative effort. Through the medium of pension plans and with the help of his employer, it is made possible. Moreover, because the employee himself contributes towards the purchase of his own retirement income benefits, the cost to the employer of co-operating in a plan of this nature is brought within reasonable limits.

Although the actual underwriting of the Plan is in the hands of the three companies named, the responsibility for its practical administration rests with a committee appointed by The Hydro-Electric Power Commission of Ontario. This Committee meets regularly and deals with questions concerning the entry of municipalities and other administrative details.

Attached to this report are tabulations giving a list of municipalities included in the Municipal Hydro-Electric Pension and Insurance Plan as at December 31, 1936, showing the date of entry and the number of em-

ployees who have become members of the Plan; a summary statement respecting the standing of the Plan as at December 1, 1936, and a joint deposit account showing receipts and disbursements for three years ended December 31, 1933, 1934 and 1935.

All enquiries regarding the Plan should be addressed to Mr. F. A. Robertson, Acting Secretary of the Committee. The address is the Municipal Hydro-Electric Pension and Insurance Committee, 620 University Ave., Toronto.

JOSEPH GIBBONS,
Chairman,
Municipal Hydro-Electric Pension and Insurance Committee.

* * * *

List of Municipalities Included in the Municipal Hydro-Electric Pension and Insurance Plan as at December 31, 1936

Name	Date of Entry		Number of Employees as at Dec. 31, 1936
Belleville Hydro-Electric System	Jan.,	1930	13
Bowmanville Hydro-Electric Comm.	Feb.,	1932	4
Brantford Hydro-Electric System	June,	1929	25
Chatham Public Utilities Comm.	June,	1929	25
Elmira Public Utilities Comm.	June,	1930	3
Elora Hydro-Electric Comm.	June,	1930	2
Essex Hydro-Electric System	Jan.,	1930	1
Etobicoke Hydro-Electric Comm.	Oct.,	1930	15
Fort William Hydro-Electric Comm.	Mar.,	1931	23
Galt Public Utilities Comm.	Aug.,	1929	22
Hamilton Hydro-Electric System	May,	1929	174
Hespeler Hydro-Electric Comm.	July,	1930	3
Kingston Public Utilities Comm.	April,	1931	42
Kingsville Public Utilities Comm.	July,	1930	3
Kitchener Public Utilities Comm.	June,	1929	85
Leamington Hydro-Electric System	Jan.,	1930	3
Lindsay Hydro-Electric System	Aug.,	1929	8
London Public Utilities Comm.	May,	1929	207
Meaford Public Utilities Comm.	Nov.,	1930	4
Mitchell Public Utilities Comm.	Nov.,	1931	3
Napanee Public Utilities Comm.	May,	1930	11
New Toronto Public Utilities Comm.	Oct.,	1930	14
Niagara Falls Hydro-Electric System	Sept.,	1929	21
North York Hydro-Electric Comm.	May,	1930	12
Orillia Water, Light & Power Comm.	Oct.,	1929	31

LIST OF MUNICIPALITIES INCLUDED IN THE MUNICIPAL HYDRO-ELECTRIC PENSION AND INSURANCE PLAN AS AT DECEMBER 31, 1936 *(Continued)*

Name	Date of Entry		Number of Employees as at Dec. 31, 1936
Oshawa Public Utilities Comm.	April,	1932	34
Ottawa Hydro-Electric System	July,	1929	71
Owen Sound Public Utilities Comm.	Sept.,	1929	30
Peterboro Utilities Comm.	Oct.,	1929	66
Port Hope Hydro-Electric System	Sept.,	1929	5
Preston Light & Water Comm.	July,	1930	8
Sandwich Hydro-Electric System	Aug.,	1930	7
Sarnia Hydro-Electric System	Jan.,	1930	23
St. Thomas Hydro-Electric System	May,	1929	19
St. Catharines Public Utilities Comm.	June,	1929	34
Stratford Public Utility Comm.	July,	1929	40
Stamford Township Public Utilities Comm.	Nov.,	1930	8
Tilbury Hydro-Electric System	Nov.,	1930	1
Toronto Electric Commissioners	Jan.,	1931	736
Trenton Public Utilities Comm.	Mar.,	1932	12
Walkerville Public Utilities Comm.	July,	1929	38
Wallaceburg Hydro-Electric Comm.	July,	1930	6
Windsor Utilities Comm.	May,	1929	94
Woodstock Public Utilities Comm.	May,	1929	16
Cobourg Public Utilities Comm.	May,	1933	15
Riverside Hydro-Electric Comm.	Aug.,	1936	2
Sudbury Hydro-Electric Comm.	Oct.,	1936	22
Deseronto Public Utilities Comm.	May,	1931	—

MUNICIPAL HYDRO-ELECTRIC PENSION AND INSURANCE PLAN, STANDING AS AT DECEMBER 1, 1936

1.	Number of Municipalities included		48
2.	Number of Employees included		2,054
3.	Amount of Life Insurance Benefit in force	$	4,329,300
4.	Amount of Monthly Retirement Income being purchased	$	144,554
5.	Number of Employees at present drawing pension		58
6.	Amount of Monthly Pension being paid	$	1,020
7.	Amount of Municipal Authorities 5% monthly payment	$	13,145
8.	Amount of Employees' monthly Income Annuity payment	$	7,033
9.	Number of Death Claims to December 1, 1936		94
10.	Amount paid out in Death Claims to December 1, 1936	$	192,680

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
MUNICIPAL HYDRO-ELECTRIC PENSION AND INSURANCE PLAN
JOINT DEPOSIT ACCOUNT

STATEMENT OF RECEIPTS AND DISBURSEMENTS FOR THREE YEARS ENDED 31 DECEMBER, 1933, 1934 AND 1935

	1933		1934		1935	
BALANCE, 1 January		$103,349.65		$135,180.42		$162,408.86
RECEIPTS—						
Municipal Authority 5%	$167,831.14		$165,522.11		$157,618.94	
Employees' Extra Contributions	2,654.35		3,147.38		3,178.69	
Monthly Pensions payable to Employees who have reached the Normal Retirement Age but have continued in the Service—Service Annuity "B"	5,621.82		4,409.11		4,414.27	
Unearned Premiums in respect of Service Annuity "B" covering Employees leaving the Service before completing twenty years continuous employment	2,891.69		4,772.49		7,204.59	
Interest Accrued for year at 4¼% per annum, compounded semi-annually	5,092.22		6,244.74		7,291.56	
TOTAL RECEIPTS		184,091.22		184,095.83		179,708.05
TOTAL		287,440.87		319,276.25		342,116.91
DISBURSEMENTS						
Premiums to purchase Service Annuity "B"	94,689.06		97,166.08		95,152.03	
Premiums to purchase Group Life Benefits	56,090.58		59,399.88		61,509.77	
Audit Fees	1,200.00		....		....	
Employees' Extra Contributions refunded upon leaving Service	280.81		301.43		678.24	
TOTAL DISBURSEMENTS		152,260.45		156,867.39		157,340.04
BALANCE, 31 December		135,180.42		162,408.86		184,776.87

THE BULLETIN

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Merchandising by Local Commissions

By E. E. Seger, Commissioner, Public Utilities Commission, St. Thomas

(Presented to Ontario Municipal Electric Association at Toronto, February 2, 1937)

SEVERAL valuable papers have been presented at past conventions dealing with the question of merchandising electrical appliances by municipal Hydro commissions. In 1924 our Association issued a pamphlet entitled, "Policy and General Rules for the Operation of a Hydro Shop." In 1934, the A.M.E.U. Committee on Merchandising presented a paper on "Principles and Facts as related to Public Utility Merchandising". At the Winter Convention in 1935, Mr. Mickler of the H.E.P.C. staff dealt with the "Prospects of Selling 100,000 H.P. to Domestic Users in the Next Three Years", and last summer at Ottawa, Mr. Adsett, also of the H.E.P.C. staff, spoke on "Advertising for the Hydro Utility". There have been other interesting papers and reports on this subject but these are some that have come to my notice and which afford different angles of thought in connection with the whole question of merchandising.

Your Committee has delegated me to continue with this line of thought at this time. While the subject of my remarks has been announced as "Merchandising by Local Commissions", I would ask your indulgence should I appear to generalize in some degree during the course of my remarks.

We do not operate a Hydro Shop in St. Thomas—it was discontinued some ten years ago due to certain local conditions—consequently I feel somewhat hesitant in addressing you, realizing that there are others here representing municipalities in which Hydro Shops have been in operation for many years, and who would seem better qualified to speak

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Vol. XXIV No. 3

March, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

on this subject. However, through my association of the past eight years as a commissioner and more recently as a member of your Executive, I have been in a position to make some observations and form some conclusions in this regard, therefore, it will be upon that basis that I will attempt to deal with the subject.

Before discussing the merits of the merchandising policy, we should recall the basic principles upon which the great Hydro enterprise was originally established. Most of us remember that industrial progress in Ontario in earlier years was seriously handicapped owing to its dependency upon steam power developed from imported coal. We remember how a small co-operative group of municipalities was successful in inaugurating the distribution of Niagara water power on a "Service at Cost" basis. The result has been that during the past 25 years we have enjoyed steadily diminishing rates coincident with steadily increasing use, so that to-day we are in a position to verify the contention of Hydro's sponsors, "The more you use, the cheaper it becomes."

As an illustration of this point, we observe residential users in St. Thomas in 1915 consuming 241 kw-hr. annually at an average cost of 3.59c per kw-hr., whereas in 1935, by which time continued reductions over the 20 year period had levelled costs materially, we find this same class of consumer finding uses for 2,223 kw-hr. per year, but paying only 1.23c per kw-hr., or about one-third of the original rate. Other municipalities will doubtless confirm this point as the result of similar experience.

Hence it is logical to conclude that since a consistent policy of load building has been productive of lower rates in the past, a continuance of this same policy should make for even lower rates in the future.

Might I suggest, gentlemen, that we have not yet arrived at that time when we can afford to sit back and wait for the prospective user of power to come knocking at our door, asking for service. It is essential that we redouble our efforts in establishing still greater demands for our invaluable commodity.

Hydro Shops, operated by municipal Hydro utilities for the purpose of merchandising electrical appliances, form one very important cog in the load building machine. When such retail outlets are operated efficiently, they automatically rise above the common level of the average retail store, to that of a public service, maintained for the benefit of each and every user of Hydro power, and, moreover, form a hub around which all things electrical in that community revolve.

There has been some degree of controversy in the past regarding the Hydro Shop policy. Opposition has been offered towards the operating of these stores on the ground of unfair competition to the private electrical dealers. Personally, I fail to see much strength in such argument when we consider the following points:

1. We recall the scarcity of electrical dealers in the early days—dealers properly established and qualified to serve the needs of the new Hydro users. It was vital to the new enterprise that an abundance of reliable appliances should be made available to the public at reasonable prices and on convenient terms as quickly as possible, and so the majority of those municipalities who had contracted for the first block of Hydro power, opened Hydro Shops immediately.
2. In 1914, electric ranges were practically an unknown appliance in Ontario. Some were quite skeptical as to the possibilities of cooking by means of electricity. Most of us can remember the first electric ranges — more like the buffet in our dining-room than our present day range—and yet, it was the Hydro Shops that tackled the job of getting consumers to use them. And it was only a short time until the private dealers decided that the electric range was practical, and then only did they too place it on their sales floor.
3. A similar situation occurred in connection with the first electrical refrigerators and other appliances; Hydro Shops led the way through the experimental and educational period and as soon as the practicability of the new appliances was proven, the dealers fell in line.

I mention these points, not in criticism of those who may have served as private dealers in those early days, but simply to point to a condition. Possibly had I been in that line of business at that time, I would have done exactly the same thing, in fact I believe I would have been critical of Hydro, the dispenser of kilowatt-hours, had they not gone ahead and done the pioneer work required in connection with the selling of large blocks of Hydro power.

Therefore, I am quite convinced that the operation of Hydro Shops in past years was fully warranted and their operation was responsible in no small measure for the phenomenal success of the Hydro enterprise throughout the Province. They not only brought adequate service to those communities where private dealers were in no position to cope

with the situation, but they afforded an intelligent interpretation of the consumers' needs.

There are some, however, while admitting the foregoing arguments, who claim that the Hydro Shops have served their purpose and are no longer required. My answer in that regard is simply this. Hydro Shops will always be required so long as the fundamental motive of our undertaking is the sale of power. We cannot leave it all to the private dealers. Inventive genius is ever bringing us something new in the field of electrical appliances, and there is the same need to-day, as in the past, of judging these innovations as to efficiency and usefulness, and, when found practical, of undertaking the work of educating the public to their use.

I do contend, however, that our Hydro Shops should work in complete harmony with the private dealers. These dealers, while naturally deriving their existence from the profits gained from the sale of electrical goods, are serving the utility through every sale they make. Every range, iron, toaster, and lamp bulb, supplied to a Hydro consumer from these stores simply means the sale of more kilowatt-hours by the utility. Consequently the dealers should be encouraged, bearing in mind that even though one of them may beat the Hydro Shop out of a sale, the dealer's profit ends with the transaction, while Hydro has gained a substantial user of power for the ensuing 15 or 20 years.

A properly operated Hydro Shop should benefit the Hydro utility along the following lines:

1. It will give leadership in promoting the sale of electrical appliances in the community it serves.
2. The operation of a Hydro Shop should be the means of urging other dealers towards greater sales efforts and better service.
3. It will provide an invaluable service in the introduction of new types of appliances.
4. It can offer unbiased advice to the perplexed Hydro user, either in the purchase of new equipment, in the repair of old equipment, or in the proper method of operating his appliances so as to gain the best efficiency.
5. It serves the needs of the Hydro consumer who prefers to deal with the Hydro when the time comes to purchase appliances.
6. It provides service repairs at cost, and in some instances below cost since Hydro realizes that adequate compensation will be obtained in return for any "free" service rendered through the sale of additional current.

In my remarks up to this point I have referred to the value of Hydro Shops. We must bear in mind, however, that many municipalities do not merchandise, consequently, the consumer who is desirous of purchasing appliances is wholly dependent upon the agencies of the private dealers. In such non-merchandising municipalities the utility should adopt some definite policy whereby they automatically accept

their share of the common obligation of load building.

At first glance it might be assumed that since no merchandising department is maintained, there is little that can be done. This is hardly the case when we consider suggestions along the following line:

1. Advertise!—Map out a carefully planned series of advertisements of an educational nature. These may deal with a variety of subjects ranging from the merits of electrical cooking, refrigeration, flat-rate water-heaters, etc., right down to the details of the latest reduction in rates, all of which is of interest to the Hydro user and the public generally.
2. Remind your employees that they should set an example in the community by using electrical appliances 100 per cent. Every employee should serve as a salesman to a certain degree, especially in his own circle of friends, urging them to use electricity whenever possible.
3. Home Lighting Advisors, engaged for the winter months only, might be retained permanently throughout the year, devoting their time in off-season periods to the promotion of electric cooking, refrigeration, etc.
4. Sponsor public gatherings such as those which were held in many municipalities in connection with the Better Light Campaign.
5. Maintain intimate relations with your electrical dealers and exhibit friendly interest in their welfare. The following suggestions are offered:
   (a) Make frequent calls at their stores; this affords the dealer an opportunity of seeking advice as to rates so as to estimate the cost of operating appliances and solving other problems; these calls also give you the opportunity of satisfying yourself that he is maintaining a reasonable standard of service to your consumers.
   (b) Arrange frequent meetings of all dealers in your office. Such meetings can be of mutual benefit and serve to keep the utility informed as to the attitude and needs of consumers.
   (c) When office space permits, invite dealers to display their ranges, refrigerators, etc., in your building so they will be available for inspection by consumers when paying bills.
   (d) Encourage dealers to exhibit appliances at community carnivals, fairs and similar attractions. Obtain space at such exhibitions and arrange an attractive display of your own.

There are, no doubt, other suggestions that might be included as well; however, I believe these should suffice to help you decide just how active you are in your municipality in the matter of load building.

In conclusion, might I suggest that there does seem to be a very definite obligation resting with each one of us as members of this Association in the matter of increasing the sale of power in our several communities; if we have not given the ques-

tion serious thought in the past then we should resolve to do so in the future.

That municipality which is content to erect poles, string wire, read meters and collect accounts, is hardly measuring up to the qualifications of a true and loyal member of the great Hydro family. Some municipalities may have become somewhat apathetic in their promotional endeavors due to a sense of security in the knowledge that they enjoy a monopoly in their field and that any new business will automatically fall right into their lap. This attitude is, of course, absurd. It is my contention that, due to the very fact that we do hold a monopoly in the sale of current, we are definitely obligated to offer a quality of service even superior to that which might suffice under ordinary competitive conditions.

In this late day, competition is keener than ever before. Throughout a large section of the Province we see natural gas utilities putting forth an even more determined effort to increase the sale of their commodity. Hydro utilities must be equally or even more aggressive in their search for new business. We must maintain a constant pressure behind the sale of current consuming appliances and service must be maintained at the highest possible level. Only by following such a course can we satisfy ourselves that we are remaining true to those traditions established and cherished by our leader of the past, the late Sir Adam Beck, and to the people whom we serve.

J. E. Brown, Ottawa, Retires

John E. Brown, General Manager of the Ottawa Hydro-Electric Commission, tendered his resignation at a meeting of that Commission on February 15th, after more than thirty years of service with the City of Ottawa, the resignation to go into effect on March 1st, 1937.

Mr. Brown's experience with the electrical industry extends over a period of fifty years. In 1887 at the age of eighteen he entered the service of Prince Edward Island Electric Company and later in that year went to the Royal Electric Company of Montreal, where he served an apprenticeship course of three years, and later also one year with the Thompson-Houston Company of Lynn, Mass. While with the Royal Electric Company he was engaged in installing electric street lighting plants in different cities.

In 1890 Mr. Brown was appointed electrical engineer of the Standard Electric Company at Ottawa, a company distributing light and power in that city. In 1896 he became electrical engineer of the Hull Electric Company, Hull, Quebec. This company took over the Aylmer branch of the Canadian Pacific Railway and equipped it electrically, being the first electric railway equipped for hauling freight in Canada. He was appointed electrical engineer for the Ottawa and Hull Power Company's Hydro-Electric plant in 1901, and also constructed in Ottawa the Consumers' Electric Company distributing system. In 1895 the City of Ottawa purchased the Consumers' Electric Company

plant which was the beginning of the present system of the Ottawa Hydro-Electric Commission, and Mr. Brown was appointed manager. In 1914 he was made General Manager.

Ottawa was the first municipality to contract with the Hydro-Electric Power Commission for a supply of electricity, the agreement of 1907 being for a total of 1,500 horsepower. During 1935 the average load taken was over 26,000 horsepower. Mr. Brown is recognized as having been responsible in a large measure for the success which Ottawa's Hydro System has enjoyed.

We are not advised as to Mr. Brown's future plans which we are informed he does not wish to disclose at this time. Whatever they may be we wish him every success and trust that he may be long spared to enjoy the best things of life.

Ottawa Hydro's New General Manager

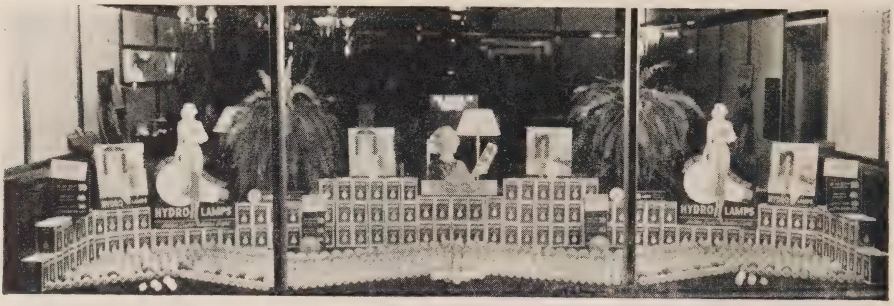
On the retirement of J. E. Brown as General Manager of the Ottawa Hydro-Electric Commission on February 15th, 1937, his assistant, Stanley W. Canniff, was appointed to succeed him.

S. W. Canniff

Mr. Canniff was born at Napanee, Ontario, in 1885, and there received his early education. On leaving high school he entered the employ of the Canadian General Electric Company as apprentice in electrical engineering. Having completed his apprenticeship he was put in charge of the factory test on transformers and two years later was promoted to the engineering department on switchboard design. In 1912 Mr. Canniff was transferred to the Canadian General Electric head office at Toronto as engineer in the supply department.

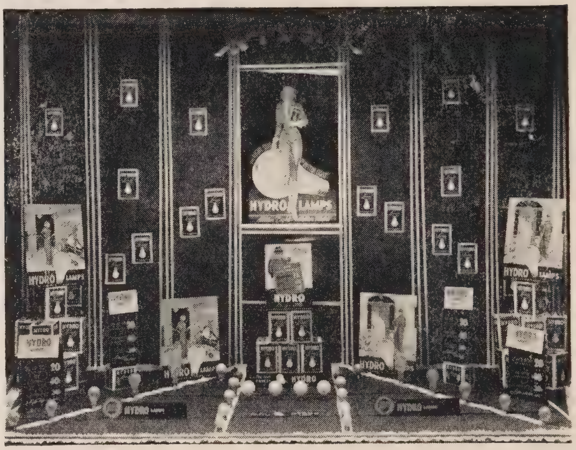
Leaving the Canadian General Electric Company in 1914, Mr. Canniff went to Ottawa to take the position of engineer on the staff of the Ottawa Hydro-Electric System. He served in this capacity until four years ago when he was made assistant general manager; and has now been promoted to the office of General Manager.

Mr. Canniff is a member of the Association of Professional Engineers of Ontario and also of the Engineering Institute of Canada.



Tie First Prize, Class 3, Picton Public Utilities Commission.

At Right—Tie First Prize, Class 3, Ingersoll Public Utilities Commission.



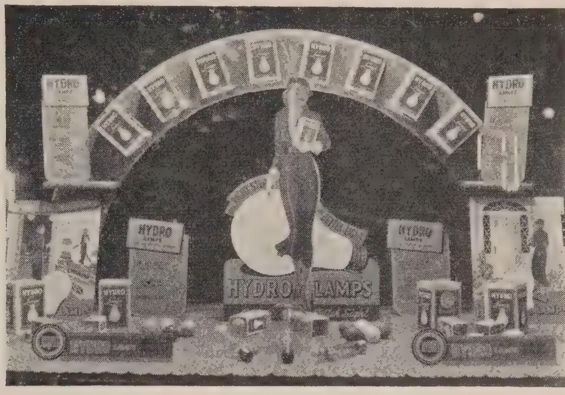
Tie Second Prize, Class 3, Hydro-Electric Power Commission of Ontario, North Bay.

Hydro Lamp Window Dressing Contest Awards

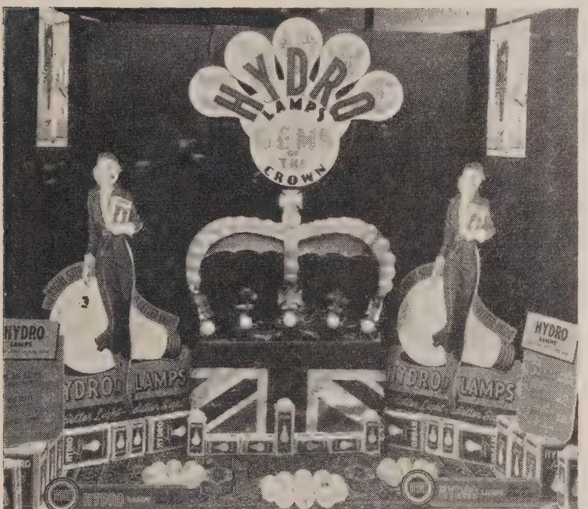
Class 3

The Class "3" awards in the 1936 Annual Hydro Lamp Window Dressing Contest depict those displays from the Hydro Shops located in the smaller towns not so well equipped with display windows. In most cases they represent the efforts of various non-selling members of the staff who are not trained in display methods.

The sales value of the displays are self evident. It is needless to add that these entrants enjoy the oppor-

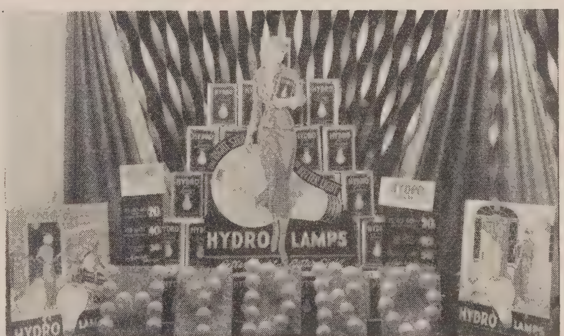


Tie Second Prize, Class 3, Napanee Public Utilities Commission.



At Left—Tie Third Prize, Class 3, Brighton Hydro-Electric Commission.

tunity of matching their ability to create sales windows for Hydro Long Life Lamps with the many other towns in this group.



Tie Third Prize, Class 3, Exeter Public Utilities Commission.

Inter-Relations Between Local Commissions and Management of Utilities

By G. S. Matthews, Chairman, Utilities Commission, Peterborough, Ontario

(Presented to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Toronto, February 3, 1937.)

THE subject that has been allotted to me to discuss is rather a difficult one, because I am addressing a gathering composed of local commissioners, managers and employees of local commissions, and a few employees of the Hydro-Electric Power Commission of Ontario upon the inter-relationship of one to the other in the control and management of Public Utilities.

Whether or not I am qualified to discuss such a subject is doubtful, and so, at the risk of being personal, I will simply mention that I have been a commissioner for twelve years, and manager of a packing plant for eighteen years.

To determine just what is the inter-relationship of local commissioners and management of utilities, it would seem necessary that one should first find out by whom these people are appointed; what powers are vested in them; and to whom they are responsible.

To obtain this information it is necessary that one refer to the Statutes of Ontario and if a layman's common sense interpretation of these Statutes is not correct I refer you to your solicitors for a legal opinion.

I do not think that there is any doubt that the municipal corporation that enters into a contract with the H. E. P. C. is still the owner of the utility. The municipal corporation may, by by-law passed with the consent of the municipal electors, delegate to a local commission the construction of the works and the control and management of the same.

Commissions consist of either three or five members. In municipalities less than 60,000 population, commissioners are elected by the people. In a city having a population of 60,000 or over, the commission consists of three members: one appointed by the council of the city, one by the H.E.P.C., and the third is the mayor of the city.

The Public Utilities Act and the Power Commission Act specify that commissions are appointed to control and manage certain utilities owned by the municipal corporation.

The Power Commission Act, however, limits this control and management of commissions and, because I

want to further define the powers of commissioners, I must deviate slightly from my subject and bring in the relationship of local commissioners to the H. E. P. C.

The question as to whether rates charged for electricity can be set by a local commission without the approval of the Provincial Commission has often been discussed.

Part of Section 82, subsection 1, of the Power Commission Act reads as follows: "The rates chargeable by any municipal corporation generating or receiving and distributing electrical power or energy shall at all times be subject to the approval of the Commission."

Subsection 2 of this Section reads in part: "The Provincial Commission may from time to time, when in its opinion it is in the interest of the municipal corporation under contract with the Commission so to do, make orders fixing the rates to be charged by the corporation or commission of any municipality having a population of less than 200,000."

Whether they have the same power in cities above this population I do not know nor do not care to discuss at the present time.

Commissioners' control and management of local utilities is further restricted by Sections 83, 85 and 86 of the Power Commission Act. These Sections, abbreviated, say that: The H. E. P. C. may prescribe a system of bookkeeping, etc., for any local commission. Local commissions must maintain insurance against loss or damage to the properties of employees, or others, and the insurance shall be for such amount and upon such terms and conditions as the Commission may direct and approve.

The Provincial Commission may direct the action to be taken in the collection of arrears. It directs the way you spend your earned surpluses.

In Section 87 of the Act are listed offences a commissioner may commit. Briefly they are as follows:

1. Supply power at rates not approved by the Provincial Commission.

2. Grant special terms by way of bonuses.

3. Neglect or refuse to follow the Provincial Commission's instructions for collecting arrears.

4. By any means whatsoever reduce the cost of power to any firm or corporation below the approved rates.

5. Fail to keep accounts in the proper manner prescribed by the Provincial Commission.

For these offences the penalty may be:

Disqualification for at least five years, or, as per Section 90, forfeit $100 a day as long as one refuses to carry out an order of the H. E. P. C. made under certain sections of the Power Commission Act.

I have not listed all of the regulations that affect the powers of local commissioners, but I believe that I have covered the most important ones.

I have told you that local commissioners are elected or appointed to control and manage the local utility. Their control is limited by Provincial Legislation and, if they fail to obey this legislation, they may be disciplined. If they fail in duties not covered by legislation they will be judged by those who appoint or elect them.

Managers and staffs of local utilities are appointed by local commissions. They are responsible to these commissions and their employment can be terminated by them.

Due to the fact that the Power Commission Act curtails powers of local commissioners, I often think that managers consult members of the Provincial Commission's staff without the knowledge of local commissions about matters of policy. This, naturally, causes ill feeling, and is, therefore, unwise. A manager of a utility should keep his commission, through the Chairman, informed of any such conference.

Likewise, I do not think that the Provincial Commission should call into conference managers of local utilities, except by request through the local commissions.

Some commissions, too, are to blame for not obtaining information they should from their manager because insufficient meetings have been called, even after frequent requests by the manager. I believe that you will all agree that this is wrong.

For an infringement of the Power Commission Act the commission is liable—not the manager.

The manager should be protected by properly recorded minutes of commission meetings, particularly as regards to instructions with which he does not altogether agree. While he is directly responsible to the local commission he should have this protection because commissions frequently change.

A manager should try to protect his commission by pointing out infringements of the Power Commission Act.

A local commission is established to control and manage the utility and it is its duty to decide all matters of policy. It is the duty of the manager to see that these policies are carried out impartially, and to supervise the detail work of management.

Commissioners and their staffs must be continually mindful of the fact they are operating a utility owned by the people and that it is their duty to see that good service is given at reasonable cost.

Commissioners should not directly interfere with their employees. If a commissioner wants to criticize an employee he should do so through the manager.

The manager should have the power to discharge an employee, but his powers in regard to increasing the number of employees should be limited. His powers to fix the remuneration paid employees should also be limited.

The manager should have the authority to make ordinary purchases of materials and supplies without first consulting his commission. Any purchases out of the ordinary he should have approved by the commission before making them.

It has been drawn to my attention that in certain towns publicity is given out by the manager without the approval or knowledge of the commission. There is a danger that such a practice might cause ill feeling, particularly if the news comes to the commission via the newspaper instead of direct from the manager.

Conventions, such as the one we are now attending, are of real value to managers and senior employees of

local commissions. The papers and discussions are usually educational, and the contacts and friendships made are valuable.

While commissions have the power to prevent their employees attending conventions, I believe they would be short sighted and unwise if they did so. I often think, however, that too many commissioners attend certain conventions more for an outing than anything else.

Commissions and managers can do a lot for their employees. Pension and insurance schemes are commendable, and in addition, I am a staunch supporter of commissions, as well as private companies, who give their hourly rate employees holidays with pay.

Usually an hourly rate employee is just as loyal to his employer as those on salary, and it seems to me to be unfair that the latter should get holidays with pay and the former not.

In view of the fact that the local commissions are vested with all the rights, responsibilities and privileges of the local council in connection with the operation of the utility I would suggest that the local commissions should be jealous of these rights to such a degree that they will not countenance any interference from the local council.

The local commission should also be careful to see that regulations are impartially enforced. A Public Ownership scheme is primarily a partnership based on complete co-operation. Where partiality is shown it invariably causes trouble and hard feelings.

In the collection of accounts the management should be given rigid backing by the commission. In some localities commissioners feel called upon to deal with these accounts individually rather than as commissioners. This, to my mind, is wrong.

It is even worse if partiality in the collection of accounts is shown commissioners. I understand that this is a source of trouble all over the province. Commissioners let their accounts accumulate, and then, in fairness to all concerned, they cannot put pressure on others.

It has even been suggested that some provision be made in respect to commissioners, such as that in the Municipal Act in respect to councillors, that electric accounts as well as taxes must be paid before a prospective commissioner is allowed to qualify for election.

I am firmly of the opinion that the manager should be required, at least monthly, to present written reports of various phases of local operations. Such reports are informative to the commissions and the preparation of them is of value to the manager.

When I was asked to prepare this paper it was suggested that I should deal with the question as to whom should be appointed secretary-treasurer of a commission. I find on making enquiries that under Section 36 of the Public Utilities Act, the powers of the local commission are similar to those belonging to the Municipal Council. They, therefore, can appoint their own executive officers, and with the exception of Police Villages, there is no specific direction given them concerning the appoint-

ment of these officers, except that under the Municipal Act it states that, "A Treasurer, Clerk or any Municipal Officer, employee or servant shall not be eligible to act as a member of the Council" and consequently a similar restriction is placed on members of the local commission.

From the above you will see that the local commission, generally speaking, has the right to appoint a secretary and treasurer and they are not restricted except as to the appointment of one of their own commissioners.

A considerable number of local commissions have appointed their superintendent or manager to act as secretary, and in most cases this works out satisfactorily. In other instances, however, it is far from satisfactory. It would seem to be advisable to have some party, other than the manager, designated as secretary.

Situations do arise whereby information that the commission should have placed before them has been suppressed because of its being derogatory to the methods employed by the manager himself. This experience was very vividly brought to attention quite recently in a western town where the manager was also secretary and treasurer of the local commission, and in consequence was able to manipulate the various records to a very considerable degree.

In conclusion I would say that despite all the safeguards and penalties provided by the law, in the last analysis, dependence has to be placed on the honesty of the manager and the staff. Commissioners must see that they have honest, courteous and reliable employees, and the best method for ensuring this is for the commissioners themselves to set an example of these simple virtues.

When there is harmony between employer and employee, plus honesty, courtesy and impartiality in dealing with the consumers, then the best interests of the public will be served.

Ground Line Preservation of Wood Poles

By Wm. Volkman, Vice-Chairman Research Sub-Committee on Treatment of Wooden Structures

(Presented to Association of Municipal Electrical Utilities at Toronto, February 2, 1937.)

BY way of an introduction to this paper I am going to ask if you have ever given any special thought as to the condition of the poles you are relying upon for the distribution of your product and upon which your customers rely for service, or have you just left them to take care of themselves after they are once installed? If your system is one of the latter you may find yourself faced with a very considerable expenditure as a result of your poles rotting at, or just below, the ground line.

A visual examination of the portion just above the ground line will not disclose the weakened portion which in practically all instances is in the section immediately under the ground and extending down about 18 inches. The maximum decay occurs where the balance between air, moisture and temperature is best suited for fungus incubation and growth. The fungus spores, or seeds, are present in all natural soils as well as in the air. Western and Eastern cedars are most commonly used for poles in Ontario and while these woods are more resistant to decay than the pines and spruces, even these in their natural condition will eventually be destroyed where conditions are such as to favor fungus growth.

There are between 500,000 and 600,000 poles installed on the transmission and telephone lines of the Commission, approximately 85 per cent. of which are Eastern Cedar, 10 per cent. Western Cedar, with the balance made up mostly of Jack Pine, Southern Pine and Spruce. These represent an investment in the millions of dollars. It is only natural, therefore, that we, as well as all other pole users, should be vitally interested in prolonging their life from a financial viewpoint as well as conservation of the natural resources of our country. Our Purchasing Department advises that they are finding it increasingly difficult to obtain cedar poles meeting our requirements due to the smaller stands of available timber, resulting also in constantly advancing prices.

From our records and the experience of other companies, that part of untreated cedar poles above the ground line has an average life considerably in excess of thirty years, whereas the wood at the ground line, if unprotected, deteriorates to such an extent that the pole will have to be lowered, replaced or reinforced long before the top has reached its

ultimate life. Our records indicate that this period may be as short as 8 to 10 years under certain soil conditions; as a further illustration—untreated stubs in our test beds show ½ to ¾ inch ground line decay in from two to four years. External decay is by far the major problem in Ontario, although we find a few poles that have to be replaced or reinforced as a result of woodpecker holes, centre rot and ants.

As an illustration of the effect of external ground line decay on the strength of poles, an examination of the curves (Fig. 1) on a 12 in. diameter Eastern cedar and a 10½ in. diameter Western cedar pole, which have about the same initial strength, shows that one-half inch and one inch of external radial reduction at the ground line decreases the strength of the Eastern cedar 23 per cent. and 41 per cent. and of the Western cedar 26 per cent. and 47 per cent.

Strength tests and observations made on poles removed from service indicate that the fungus roots penetrate into the wood causing a gradual deterioration. This means that while the wood on the outside surface may be 100 per cent. depreciated, the apparent good wood nearer the centre, which may appear sound to the eye, may be in varying stages of decay and its strength thereby materially reduced.

Centre rot, which is slower in its progress since heart wood is more resistant to decay and due to its location in the pole, does not have the same relative effect on strength, for, as shown by the curves, a 10 in. hole in a 12 in. Eastern cedar causes a reduction in strength of 47 per cent., which is about the equivalent of 1 in. outside radial reduction. Observation of the progress of heart rot also appears to indicate that it is more active in poles with bad external decay.

In the interests of service to customers, conservation, protection of equipment, reduction of overall maintenance costs and cost of pole replacement or reinforcing, it is evident that protection of poles against external ground line decay is worthy of your consideration. While it is true that many poles have a considerable factor of safety when first installed, from the foregoing considerations it should be just as important to prevent or stop ground line decay on wood poles as it is to protect other types of wood structures by painting; further, the investment per pole in transmission lines is much greater than in most types of wood structure.

The Commission's engineers have been investigating the various types and methods of treating poles, suggested from time to time since 1920 and the result of our experience to date would indicate that coal tar creosote is the present outstanding material for this purpose. A number of water soluble salts have been tried, however, since the pole butt acts as a capillary moisture carrier, after the manner of a lamp wick, this type of fungicide is gradually carried up the pole by the water and deposited in the wood above the ground line, resulting in a relatively short life for this type of treatment

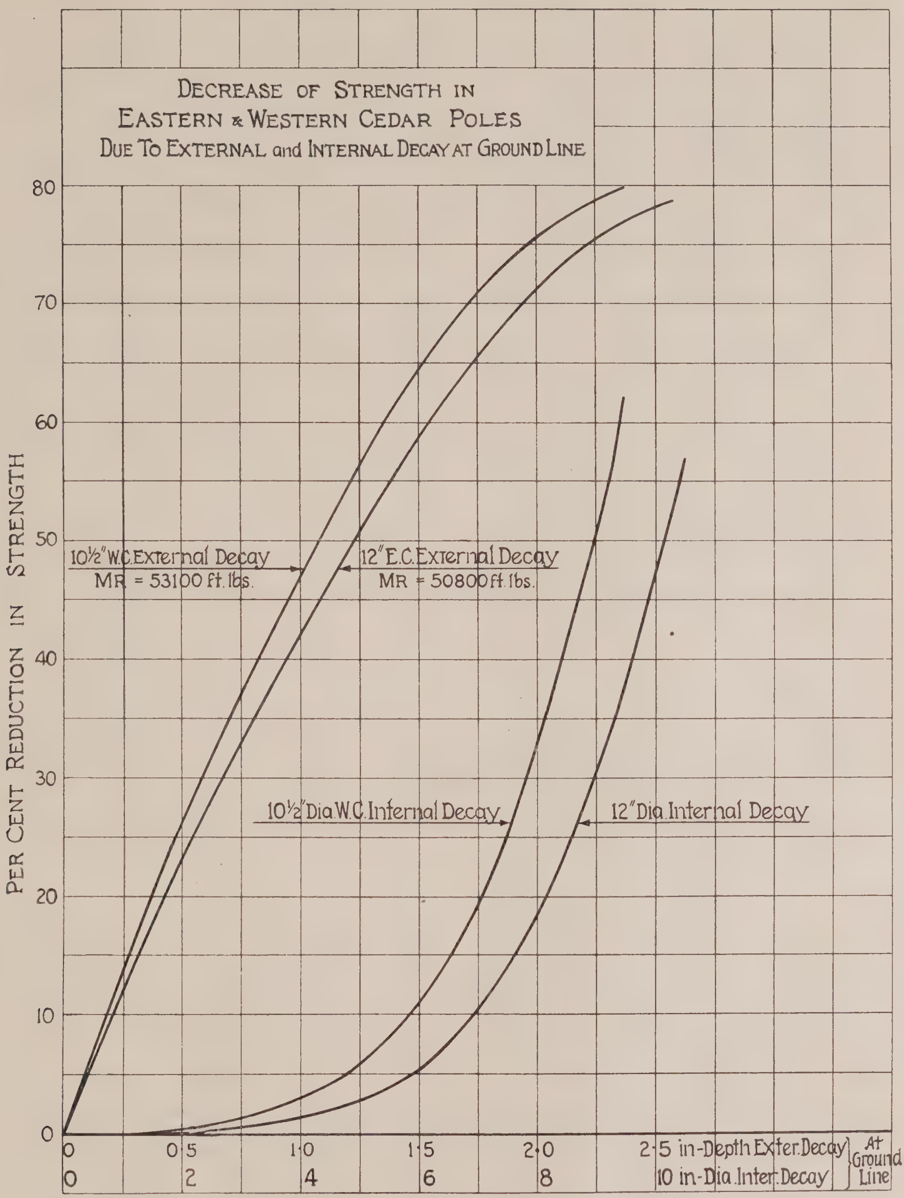


Fig. 1

as far as that portion most subject to decay is concerned.

That ground line decay can be prevented or retarded by the application of creosote, is shown by results on some sections of the Commission's lines. A group of poles installed from 1909 to 1918 which

have received very close attention to butt preservation since 1920, are now requiring stubbing and replacement at the rate of 0.26 per cent. per year, while another group of about the same average age, where close attention to butt decay was not started until 1933, are requiring reinforcing, lowering or replacing at the rate of 2.6 per cent. per year, or ten times the amount. The total labor, material and expense to rehabilitate the poles based on the total number in this latter group, is conservatively estimated at 35 cents per pole, per year. In municipalities where trees prevent lowering, and it is necessary to replace poles usually carrying a large number of attachments, the cost may run from $25.00 to $200.00 per pole.

I am informed that the Toronto Hydro-Electric System has been using the concrete creosote treating collar developed by their Mr. Brady in 1925 on all wood poles, and as a result of the elimination of external ground line decay they have been able to make a reduction in the circumference of poles purchased under their specifications resulting in lower first cost as well as a material reduction in pole replacements. This treating unit as described in the H.E.P.C. *Bulletin* of January, 1934, is quite effective as a creosote distributor as well as another type of bandage available on the market.

The Commission in the past has used various methods of applying creosote including—

Hot and cold dipping of new poles and stubs which involves shipping to a central plant with attendant handling costs.

Brush and spray treatments which can be carried out at point of installation or on standing poles.

The latter type of treatment when properly carried out and using about 1 gallon of creosote per six poles, gives a fair protection for 5 to 6 years; the ultimate life of dipping is not known but will vary with the amount of creosote absorbed by the wood.

To overcome the attendant costs of excavating standing poles for each treatment, the Commission has developed a ground line treating collar which can be economically installed on all types of poles, both new and old; this collar will give a setting as strong as the surrounding earth, provide a means for retreating without excavation, maintain a sterile area of soil around the pole to the depth of the bandage and stop the surrounding earth from drawing creosote from the pole; the capillary action of the sap wood will carry the creosote oil some distance above as well as below the collar; it will also retard the absorption of moisture from the surrounding earth in the covered area.

The collar is formed of a sheet of galvanized iron wrapped loosely around the pole above the ground line and tied with a light piece of wire. This is lowered into position, formed into shape by the insertion of tapered wedges between the pole and sheet, nailed at the overlap through the permanent wedge and filled with fine dry sand. The temporary wedges are then removed

using them as tampers and the filler brought up to the required level. The creosote is placed and after absorption the collar is completed by filling with a saturated mixture of creosote and sand.

The principle underlying the development of this method of treatment was based on the experimental observation that an 18 inch column of fine dry sand would hold from 20 to 25 per cent. of its volume of creosote, depending on the fineness and nature of the filler and that cedar in contact with this treated material will absorb approximately 75 per cent. of this creosote, leaving about 25 per cent. in the filler, which in itself is sufficient to inhibit fungus growth. Tests and observations to date indicate that under ordinary conditions, this residual creosote will not be leached out by water.

While all of the tests have been carried out on cedar it will be recognized that it will be equally effective on any wood that will absorb creosote. In the case of spruce, which will not absorb oils, the area covered by the collar will be protected from fungus attack.

Having established the above principles, the next step was to develop a method of application which would be relatively inexpensive and easy to handle with a reasonable small chance of misapplication, as the work will be handled by a large number of men.

Since the amount of creosote placed in the filler is such that it will rapidly diffuse to the surrounding earth, rather than to the wood, a container is required that will keep the treatment in intimate contact with the pole. Waterproof fibrous materials are not satisfactory since they are readily softened by creosote as well as having a relatively short life underground, further, ordinary galvanized sheets having a coating of 1.25 to 1.35 oz. of zinc per square foot will not stand up. Investigation with manufacturers of galvanized plate revealed that we could obtain a light sheet carrying a zinc coating of 1.8 to 2 oz. comparable to that used in galvanized culverts which generally are showing a life in excess of 20 years in Ontario soils. We have therefore standardized on a No. 28 gauge sheet, which is light enough to handle, with this special coating.

Should you desire to purchase galvanized iron for this class of work your orders should call for sheets to be galvanized to grade B of A.S.T.M. Specification A93-27, with a minimum zinc coating of 1.8 oz. as noted on page 1 of H.E.P.C. Specification No. 360630, Appendix I.

Having selected the gauge of the sheet, size is the next consideration. Standard dimensions of plate are 36 in. by 84 in., 96 in., 108 in., and 120 in. long. Since the area affected and requiring treatment is on the average about 18 in. and pole circumferences vary from 30 in. to 50 in., we are able to quarter the standard sheets and obtain sections 18 in. wide by 42 in., 48 in., 54 in. and 60 in. long without waste.

As noted in the foregoing in order to take full advantage of the creosote it is very essential that the filler in the bandage does not come in direct

contact with any portion of the earth surrounding it, therefore, a relatively tight seal is necessary at the base of the collar. This is accomplished by forcing the tapered wedges between the sheet and pole against the pressure of the tie wire which is placed about 4 to 5 in. from the bottom. If this operation is carefully carried out and there are no uneven surfaces on the pole or clods of earth to prevent the sheet pulling tight, the bottom will be sufficiently close to prevent undue wastage of creosote.

The filler or creosote carrier used is preferrably a very fine sand since this gives up the largest percentage of creosote to the wood, however, in the absence of sand of this type any fine earth after passing through a copper fly screen (12 mesh) will serve the purpose. The important points to be stressed on the filler is that it be sufficiently dry to flow freely into all crevices so that the creosote will be carried to all exposed surfaces, and that it be sufficiently fine to hold the amount of creosote applied. It is desirable that you check your general run of filler on this latter point; this can be readily carried out in the field by tamping the proposed material in a 20 inch length of pipe (any diameter), set on a flat sheet of metal, to a depth of 16 inches and floating creosote on top to a depth of 3 inches. If there is very little loss of creosote from the bottom of the container after 8 or 10 hours at normal room temperatures the filler is satisfactory.

After the formed collar is in place and partly backfilled, the sand is poured in, the old-fashioned coal scuttle is very convenient for this purpose, and the temporary wedges gradually removed using each in turn as a ram to consolidate the filler. This is to be carried up to 2½ in. from the low side and levelled off so that the creosote will be equally placed around the pole.

The creosote is now run in to a depth of 2 inches all around; this amount is equivalent to 25 per cent. of the filler on new poles. The amount required will average out to about ½ gallon per pole on Eastern cedars. It will take from 15 minutes to one-half hour for the creosote to sink into the filler and from one to two hours to reach the bottom.

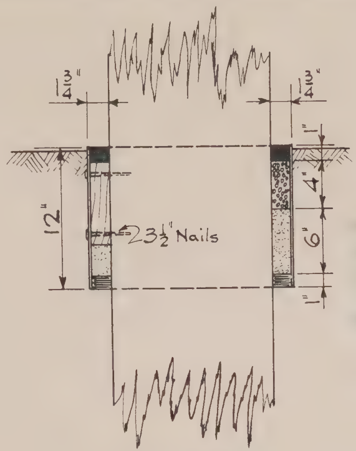
The final filling of the collar is carried out with a saturated mixture of sand and creosote trowelled into place. This is necessary to provide a proper seal at the top; if dry sand only is used the creosote below will not pull up and saturate it, thus allowing the sand to be readily washed out by rain, if, however, it is saturated with creosote before being placed, a light crust will form on the top which will shed any ordinary flow of water.

We have not as yet been able to gauge the frequency of further creosote applications. The Toronto Hydro-Electric System, however, has found it desirable to re-treat every three years.

H.E.P.C. Specifications No. 360630 covering complete detailed instructions on the application of this method of treating as now in use on our System, is given in Appendix I.

As there will be locations in some municipalities where the top of the galvanized collar needs to be the same height all around, particularly for

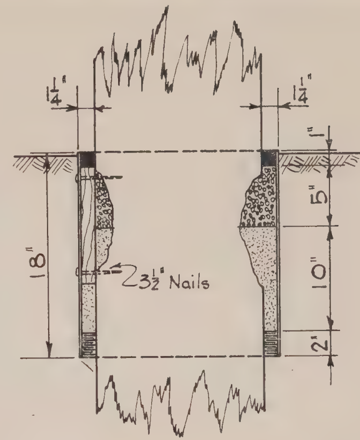
FIGURE 2
SUBURBAN TYPE
SAND-CREOSOTE COLLAR



NEW POLE

MATERIALS

MATERIALS	QUANTITIES NEW POLES	QUANTITIES OLD POLES
Hot Pitch Seal	3 lbs.	2 lbs.
Pea Gravel, well tamped	1-$1\frac{1}{2}$ gal.	1-2 gal.
Fine Dry Sand, well tamped	$1\frac{1}{2}$-$2\frac{1}{4}$ gal.	$1\frac{1}{2}$-3 gal.
Special Cement seal { 1 pt. Plaster of Paris, 8 pts. Cement, 20 pts. Sand	1-$1\frac{1}{2}$ qts.	$1\frac{1}{2}$-2 qts.
Permanent Wood Spacer $1\frac{3}{4}'' \times 1\frac{3}{4}'' \times 7''$	1	
do. $1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 10''$		1
Temporary Armoured Spacers $1\frac{3}{4}'' \times 1\frac{3}{4}'' \times 10''$	6-10	
do. $1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 15''$		6-10
Galv. Sheet, length 42"-48"-52"-60"	12" wide	18" wide

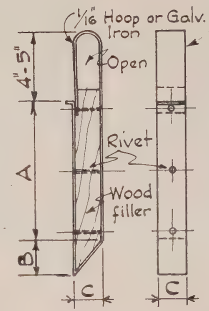


OLD POLE

OPERATION

1. Place sheet around pole above ground line and tie with long piece of inner tube.
2. Lower bandage into place and insert temporary spacers. Place permanent spacer at outer edge of overlap, nail, and remove rubber tie.
3. Place part of backfill and remove temporary spacers.
4. Mix and tamp in place special cement seal to proper depth all around.
5. Place fine dry sand and tamp.
6. Place pea gravel and tamp.
7. Fill pea gravel with creosote.
8. Seal off top with hot pitch.

To refill with creosote, puncture pitch seal on two sides of pole, using pipe and hose to place creosote thru one hole. Fill until creosote appears at other side. Remove pipe and reseal holes.



DIM	NEW POLE	OLD POLE
A	10"	15"
B	2"	3"
C	$1\frac{3}{4}'' \times 1\frac{3}{4}''$	$1\frac{1}{4}'' \times 1\frac{1}{4}''$

SUGGESTED DESIGN FOR TEMPORARY SPACER

poles set in cement walks or where a top seal is desirable, we have made an adaptation of the Toronto Hydro collar as a container for the sand and creosote.

In this application either a 12 inch or 18 inch sheet is used in a cylindrical form with a special cement seal at the base which will set up in from 15 to 30 minutes with a lower filler of fine sand, topped off with pea gravel and sealed with hot pitch. This method is fully described and illustrated in Figure 2.

* * * *

APPENDIX I.

Hydro-Electric Power Commission of Ontario Specification 360630 For Installation of Sand Creosote Collar for Ground Line Protection of Poles

Introduction

The strength of a pole is largely determined by the amount of sound wood at, or just below, the ground line. It is therefore important that the timber at this point be preserved in its original state as long as possible.

Rot first begins at the ground line of a pole set in soil and rapidly progresses downwards a foot or two and inwards through the sapwood into the heart-wood unless means are taken to preserve the wood at this vulnerable point.

Experiments have shown that creosote oil is the most effective and economical preservative agent which is known for wood under these conditions. This instruction describes the sand-creosote collar which is now standard for ground line treatment of Commission poles.

Instruction for the Sand Creosote Collar

The sand creosote collar and the method of applying it are described herewith:—

(a) Material Required per Unit

Quantity	Item
1 sheet	Specially galvanized sheet iron 18 in. wide and about a foot longer than the circumference of the pole or stub at the ground line. The following standard lengths will be carried in stock, 3 ft. 6 in., 4 ft., 4 ft. 6 in., and 5 ft. These sheets are No. 28 gauge, galvanized to grade B or the ASTM Specification No. A93-27 with a minimum zinc coating of 1.8 oz. instead of the stand- 1.75 oz. Where large poles are encountered, requiring a longer piece, the extra length may be sheared from a short sheet.
1 piece	Aluminum or soft copper tie wire not smaller than No. 10 B & S gauge—4 ft. to 5 ft. 6 in. long.
1	Wooden spacing wedge (permanent) clear pine, 1¼

	in. by 1¼ in. by 16 in. tapering to a 5/32 in. by 1¼ in. edge.
2	3½ in. wire nails.
2 to 3 gals.	Fine sand or earth sufficiently dry to flow freely. If dry earth is used it should be sifted through a sieve made of standard copper fly screen (12 mesh). Care should be taken to use only material containing a large amount of fine grains; coarse sand, such as is used in building, or coarse earth, is unsuitable since it will not hold the required amount of creosote.
½ gal. (approx.)	Approved creosote oil.

(b) Tools Required

In addition to the above mentioned materials, special tools will be required consisting of:—

6 to 8	Armoured wooden wedges (as per sketch attached); containers for handling the creosote and sand, pliers, snips, hammer, round nose garden trowel, hand screen, shovels and tamping bar.

(c) Preparing the Pole for the Collar

Poles and stubs that are being erected shall be back-filled to within 18 in. of the ground level, and all the earth cleaned off the pole above this point. On standing poles and stubs that are to be equipped with the collar, the earth shall be excavated for a width of 9 in. around the butt and to the depth of the rot. All of the rot shall be cleaned off, using a 3 in. carpenter's slick or other similar approved tool. The hole shall then be backfilled and tamped to about 18 in. from the ground line.

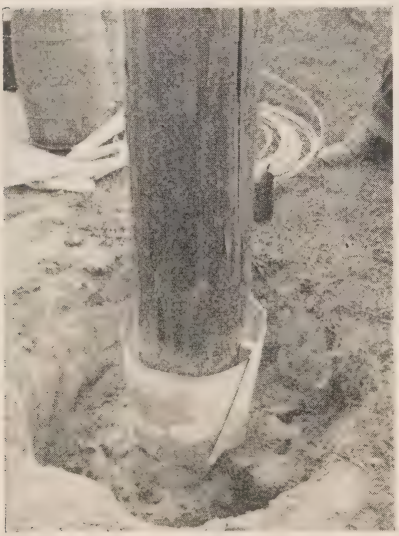
(d) Installing the Collar

1. The galvanized sheet shall be wrapped around the pole at a convenient height, and drawn up to an average distance of ½ in. from the surface of the pole by the tie wire.
2. The tied sheet shall be lowered into the hole until the top is 1 in. above the ground level, and the tie wire slipped down to 4 in. or 5 in. from the bottom of the sheet.

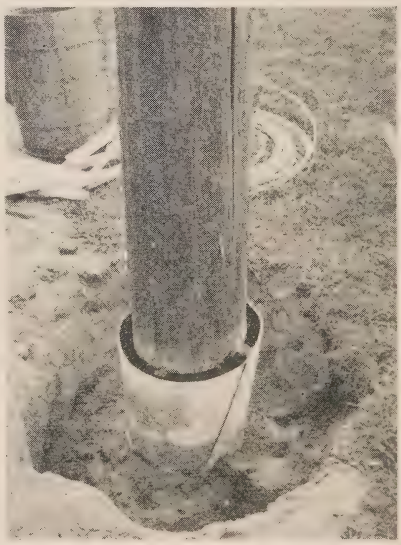
   NOTE.—*The collar should be kept clear of the bottom of the hole so that soil will not interfere with the lower edge of the sheet closing tightly around the pole.*
3. The permanent wooden spacing wedge shall be pushed, point first, down between the iron sheet and the pole at the centre of the overlap until the top of the wedge is flush with the top of the sheet.
4. Six or eight temporary (armoured) wedges shall be inserted in a similar manner between the iron sheet and the pole, and equally spaced around the pole. This must draw the lower edge of the sheet tightly to the pole surface and force the top edge about 1¼ in. away from the pole; thus providing a cone-shaped container surrounding the pole at the ground line and below. If a close fit is not obtained the tie wire should

Sheet of galvanized iron wrapped around pole and tied with aluminum tie wire.

Collar lowered to position, wedges placed and partly filled with sand.

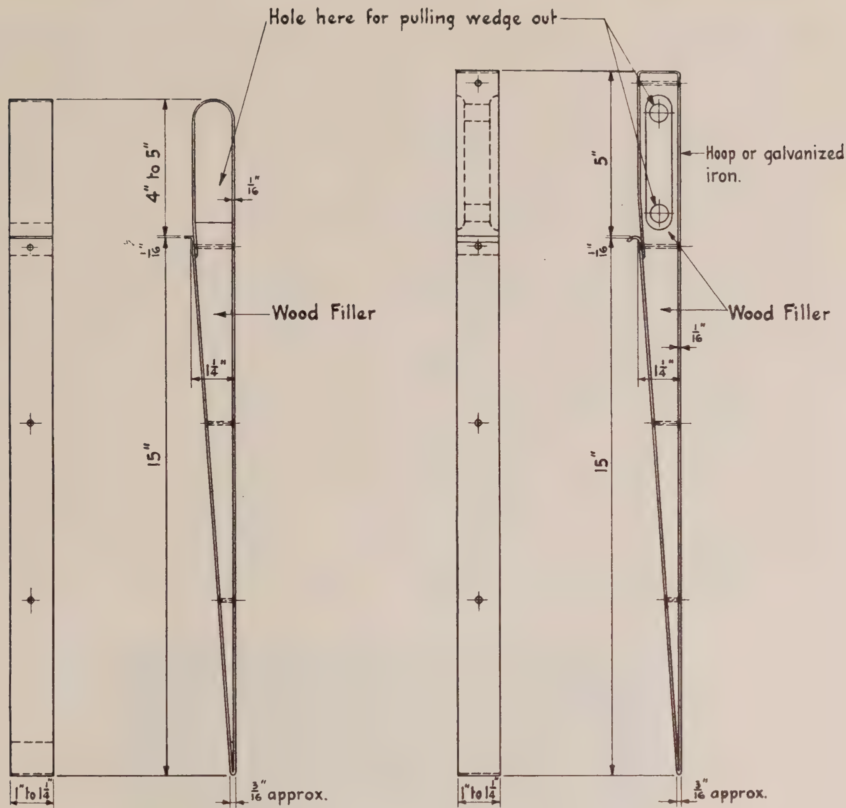


Temporary wedges removed.



Sand-creosote collar installed ready for the back-filling operation.

Sand-Creosote Collar



Note:

If hoop iron is used, chamfer edges to avoid cutting galvanizing.

These wedges may be made locally.
The above designs are only suggestions, and may be modified where desirable.

DESIGN SUGGESTIONS FOR ARMOURED WEDGES FOR USE WITH THE SAND—CREOSOTE COLLAR

Operating Dept. Toronto. April 23.36. T.F.C.

be either raised or tightened. If pole is irregular at the bottom, the iron sheet should be hammered into the depression.

5. Two $3\frac{1}{2}$ in. nails shall be driven through the iron sheet and permanent wedge into the pole, starting the first near the top

of the sheet and the other 6 in. below it.

6. The top corners of the iron sheet, where they project over the top edge, shall be bent down over the sheet, so as to lock it.
7. About 4 in. of the soil shall be thrown into the hole surrounding the collar, and tamped.
8. The collar shall be filled with dry sand or earth, as noted in (a). The temporary wedges shall then be gradually removed using each in turn as a ram to consolidate the material into the irregularities of the pole. When all of the temporary wedges have been removed the collar shall be filled and tamped to within $2\frac{1}{2}$ in. from the low side of the collar and levelled off. It is essential that material in the collar is level in order that the creosote may be evenly distributed around the pole.
9. Creosote shall be poured in top of the collar to a depth of 2 in., and while this is being absorbed by the filler, the back-filling shall be completed and thoroughly tamped.
10. After the creosote has been absorbed, the top of the collar shall be filled with a saturated mixture of sand or earth and creosote and levelled off.

The installation is then complete.

Pipe Thawing

By R. L. Dobbin, General Manager, Utilities Commission, Peterborough, Ont.

(Presented to Association of Municipal Electrical Utilities at Toronto, February 3, 1937.)

ELECTRICAL thawing of frozen water pipes has been practised in Ontario since 1905, and perhaps earlier and has proved a valuable service for water works plants. Almost every water works system has experienced frozen service pipes, and prior to the use of electricity, the only method of thawing them was by digging down to the pipe and applying steam or hot water. This was laborious and expensive and took considerable time. When the electrical method was developed it was hailed with great satisfaction. The principal methods of electrical thawing are as follows:

(1) Standard Distribution Transformers.

(2) Special Low Voltage Transformers.

(3) Engine Driven Generator Sets.

Storage battery sets have been used to a limited extent in the United States, and will not be considered in this paper, except to record their use.

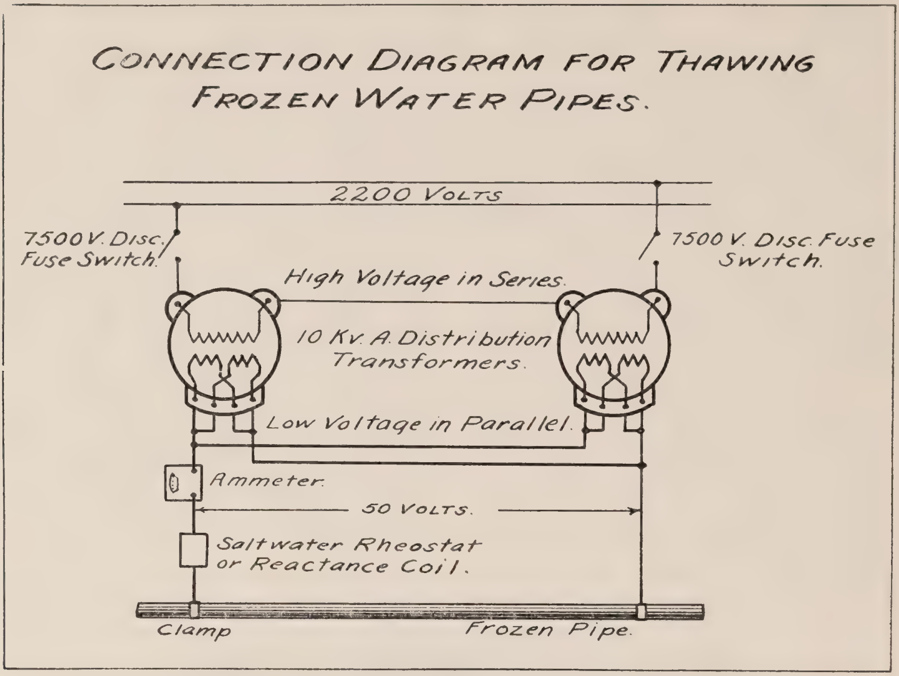
(1) Standard Distribution Transformers

These sets usually consist of two 10 kv-a. transformers connected to the primary distribution circuits, placed on a truck with fused disconnecting switches mounted on a cross arm above them. If the primaries are connected in parallel, and the secondaries also, the secondary voltage will of course be 110/115 volts and current up to 350 amperes can be delivered for intermittent service. If the primaries are connected in series, and the secondaries in parallel, the secondary voltage will be reduced to 45 or 50 volts, with a corresponding higher current value. This latter connection is the one used in Peterborough, and a diagram is included in this paper. Variation in the secondary current can be secured by coiling the secondary leads to form a reactance coil, or by using a salt water rheostat.

For primary leads bare copper cable and mechanical connectors can be used. For the secondary leads extra flexible rubber insulated cable is required of a size not less than No. 00. It should be in 25 or 50 foot lengths with suitable mechanical connectors between lengths.

For connecting to the water pipe or fire hydrants special connectors have been developed and a great deal of care should be taken to see that these are properly applied so that heating at these points will be kept to a minimum.

These sets have the advantage that all material used, except perhaps the secondary leads, can be taken from



stock and returned there when the winter is over, and in some winters there are no services to thaw.

Special Low Voltage Transformers

Of late years special pipe thawing transformers have been developed for connection to the house service wires. These can be obtained in sizes from 2½ to 5 kv-a. giving 11 to 22 volts on the secondary side, and current values from 200 to 800 amperes. They cost from $225 to $500 each.

Engine Driven Generator Sets

These consist of a gasoline engine direct connected to an alternating current generator and capable of delivering up to 500 amperes at 115 volts. They can be connected for 50 volts as well. They cost from $1,000 to $2,000, depending on the size of the machine.

They are especially useful where primary current is not available, and are used by many water works departments.

Engine driven arc welding machines have been pressed into service in some cities when there are a large number of water services to thaw, but they are expensive, and as they generate direct current the latter may cause some electrolysis if continued for some time.

COSTS

Standard Distribution Transformers

This method requires the services of a foreman, two first class linemen and two ground men, one of the latter acting as a truck driver. If the services to be thawed are close together, as they will be at times in a severe winter, from thirty to forty services

can be thawed in a day of ten hours at a cost of $1 each for labor and truck. But as a general rule the average number thawed per day will be much less, thus increasing the cost per service. In 1934 the average cost per service in Peterborough was $2.39 for the whole winter from December 1 to April 15. No charge for power is included in the above, and this should not be high as the power used can be kept off the local peak.

Special Low Voltage Transformers

The writer has had no experience with this type of transformer but would expect that the cost would be about the same as above. It might be lower in that first class linemen need not be employed, but on account of the low voltages used the job would take longer. This method would be especially useful for thawing pipes inside buildings on account of the low voltages used.

Engine Driven Sets

W. E. MacDonald, Waterworks Engineer of the City of Ottawa, who has had considerable experience with these outfits says that the average cost of thawing per service was $1.78 over the whole season of 1933-34, when 1,941 services were thawed. These costs include all labour and transportation.

In Peterborough the charge to the consumer when the frozen pipe is on his property, is $4 per thaw. When it is on the street the cost is absorbed by the Waterworks Department. As a matter of fact in severe winters when there are many thaws to be made, there is no time to ascertain where the stoppage is, and as a result the whole charge was paid by the Waterworks Department in Peterborough in 1934. A survey made by the Canadian Section of the American Water Works Association showed that the charge to the consumer for thawing water services varied from $10 to $2 per service. The average was about $4, and this seems to be a reasonable figure.

Precautions to be Taken

In thawing water pipes the practice is to attach one secondary wire to the service pipe inside the basement, and the other on the nearest fire hydrant. If two adjacent services are to be thawed one wire can be connected to each pipe.

We experimented by attaching one wire to the shut-off key which rested on the stop cock at the street line. We abandoned this practice after finding that the arc set up at the base of the key was such that the key welded to the stop cock. We would not recommend this practice.

When using standard distribution transformers the primary connections are made on live wires, and of course this work should be done in accordance with the rules for this type of connection. A first class lineman will know what should be done.

As for the secondary connections, these should be made as carefully and both primary and secondary conductors should be guarded from curious passers-by. One man should be stationed at the fused switches, and these should not be closed until ordered by the foreman who has satisfied himself that all connections are in order. A switch stick and rubber

gloves should be used by the lineman operating the switch.

Occupants of the house should be warned to keep away from all electrical apparatus and all plumbing and gas fixtures while the thawing is in progress.

All grounds of any kind in the building should be removed and the water pipe disconnected as near as possible to the cellar wall. If there is no union at this point the pipe should be cut before thawing starts.

Care should be taken to see that there are no accidental grounds between the water pipes and other plumbing or gas pipes. Sometimes a ground may develop in an adjoining house and cause a hazard. When the connections are correctly made, thawing of an ordinary water service should not take over two or three minutes. If the time runs much over this an investigation should be made of the pipe to see if there are not some insulating joints in it. Some unions have rubber or leather washers. The current will arc around these, and if left on long enough, the fittings will be melted and damaged. Certain types of jointing material for cast iron pipes is non conducting when the joints are newly made, but after being in the ground for a number of years will conduct the current much better. In Peterborough we have had very little trouble with this type of joint as far as thawing is concerned. In one case some of the jointing material melted, and we had a bad leak. The occupants of the near-by houses all complained of a sulphurous taste and smell, but this cleared up in a day or so. The sulphur probably came out of the jointing material.

Water piping inside buildings should not be thawed electrically without a great deal of care being taken. Accidental grounds are prone to happen and if the current is left on long enough a serious fire may result. In Peterborough we refuse to thaw pipes inside buildings. In conclusion, we would state that the electrical method of thawing water pipes when properly handled should not occasion any damage to property or injury to persons, and as such is a great boon to water works' systems in severe winters. It is economical and speedy, and without it the supplying of this most necessary service would be seriously crippled.

A. M. E. U. Winter Convention

The papers and addresses given during the winter convention of the Association of Municipal Electrical Utilities are reproduced in this and the following number of the Bulletin. The convention was held concurrently with the Annual Meeting of the Ontario Municipal Electric Association at Toronto on February 2nd and 3rd, 1937, when there was an attendance according to the registers of the two associations, of over 530 delegates.

The following were elected officers for the year 1937:

PRESIDENT: H. F. Shearer, Welland, Ontario.

VICE-PRESIDENT: R. S. Reynolds, Chatham.

SECRETARY: S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

TREASURER: B. Faichney, H.E.P.C. of Ontario, Toronto.

DIRECTORS (From the Membership at Large): G. E. Chase, Bowmanville; A. B. Manson, Stratford; P. B. Yates, St. Catharines.

DISTRICT DIRECTORS:

NIAGARA DISTRICT—V. A. McKillop, London.

CENTRAL DISTRICT—G. F. Shreve, Oshawa.

GEORGIAN BAY DISTRICT—J. R. McLinden, Owen Sound.

EASTERN DISTRICT—M. W. Rogers, Carleton Place.

NORTHERN DISTRICT—C. J. Moors, Fort William.

The recommendation from the Executive Committee at its meeting of February 2nd that the summer convention be held at Bigwin Inn, was referred back to that committee with power to act. When the recommendation had been considered at the Ontario Municipal Electric Association meeting, that association decided to hold its summer convention at Niagara Falls.

At the Executive Committee meeting on the evening of February 2nd, committees were appointed as follows:

Papers Committee: V. A. McKillop, London, Chairman; G. A. Brace, Ferranti Electric, Toronto; C. E. Schwenger, Toronto; R. M. Love, Canadian General Electric, Toronto; G. J. Mickler and J. N. Wilson, H.E.P.C. of Ontario, Toronto.

Convention Committee: R. S. Reynolds, Chatham, Chairman; J. E. Teckoe, Niagara Falls; J. E. B. Phelps, Sarnia; O. H. Scott, Belleville; W. R. Catton, Brantford; F. Mahoney, Canadian General Electric, Toronto; C. H. Hopper, Ferranti Electric, Toronto; G. F. Drewry and B. Mulholland, H.E.P.C. of Ontario, Toronto.

Regulations and Standards Committee: M. W. Rogers, Carleton Place, Chairman; C. E. Brown, Meaford, F. W. Peasnell, Toronto; R. L. Dobbin, Peterborough; J. Eckersley, Toronto; W. P. Dobson and A. G. Hall, H.E.P.C. of Ontario, Toronto.

Committee on Accident Prevention and Health Promotion: P. B. Yates, St. Catharines, Chairman; A. L. Farquharson, Brockville; C. E. Schwenger, Toronto, R. S. Reynolds, Chatham; J. W. Peart, St. Thomas; R. Harrison, Scarborough Township;

V. A. McKillop, London; F. D. Hubbell, Windsor; R. L. Dobbin, Peterborough; A. B. Manson, Stratford; C. C. Folger, Kingston; A. W. Murdock, B. Mulholland, E. R. Lawler and Wills Maclachlan, H.E.P.C. of Ontario, Toronto.

Merchandising Committee: A. B. Manson, Stratford, Chairman; O. H. Scott, Belleville; H. R. Hatcher, Galt; O. C. Thal, Kitchener; H. F. Shearer, Welland; R. A. Turner, Hamilton; F. Wilkinson, London; E. Parsons, Sarnia; F. S. Rhoads, Windsor; I. N. Pritchard, Chatham; G. E. Chase, Bowmanville; A. W. J. Stewart, Toronto; W. Dymond and G. J. Mickler, H.E.P.C. of Ontario, Toronto.

Rates Committee: G. E. Chase, Bowmanville, Chairman; P. B. Yates, St. Catharines; O. H. Scott, Belleville; O. M. Perry, Windsor; R. S. Reynolds, Chatham; T. R. C. Flint, Toronto; F. W. Peasnell, Toronto; W. R. Catton, Brantford; J. J. Jeffery, G. F. Drewry and S. R. A. Clement, H.E.P.C. of Ontario, Toronto.

Committee on Accounting and Office Administration: G. F. Shreve, Oshawa, Chairman; George Appleton, Toronto, Vice-Chairman; T. W. Houltby, Welland; A. B. Manson, Stratford; I. N. Pritchard, Chatham; W. E. Wallace, Windsor; M. A. Gough, East York Township; R. S. King, Midland; W. M. Salter, Barrie; C. E. Brown, Meaford; Ralph C. Parker, Penetang; M. W. Rogers, Carleton Place; H. Clegg, Peterborough; A. D. Nelson, Kingston; W. G. Henderson, Cobourg; and R. M. Bond, H.E.P.C. of Ontario, Toronto.

Auditors: H. P. L. Hillman, Toronto and W. G. Pierdon, H.E.P.C. of Ontario, Toronto.

The Executive Committee held a second meeting immediately after the close of the convention to re-consider the headquarters for the summer convention, when it was decided to defer to the wishes of the Ontario Municipal Electric Association to hold the summer convention at Niagara Falls.

O. M. E. A. — A. M. E. U.
CONVENTION
at Niagara Falls, Ont.
June 28, 29 and 30, 1937

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Let's See

By Matthew Luckiesh, D.Sc., D.E., Director of Lighting Research Laboratories, General Electric Company, Nela Park, Cleveland, Ohio.

(Address to the Ontario Municipal Electric Association, the Association of Municipal Electrical Utilities and The Electric Club of Toronto, at Toronto, February 3, 1937.)

THE lighting business has great opportunities, but far more important in my opinion is the responsibility that goes with it. Any business has a right to make a profit for itself, but the business that endures and is well worth while and does something for the progress of humanity makes a profit for the owner and the customer.

Lighting has had a fine horizontal growth. It is not much to the credit of the lighting business that the growth has been rather vast horizontally. As science develops new uses, new lighting fields come into being without much credit to the lighting business itself.

What I have looked forward to over a great many years has been a vertical growth, a growth superimposed upon the natural growth which has been horizontal. To use a common metaphor, lighting is ready for the "take-off".

But before we take off on the flight, it is always rather desirable to look over the runway. The lighting business has many ruts in its runway; habits of past practice, born of a lack of knowledge.

Lighting is a chain of three links, as I look at it. First, we produce light. Certainly, the production of light has been one of the greatest achievements of men. We won't have to produce another light-source for the next hundred years and the lighting business has a tremendous opportunity and responsibility.

The next step in lighting, or the next link, is control. We know all about control of light. There isn't a new thing to be known about control, as far as the application of a physical science of optics. However, we put

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April, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

those factors together in different ways to meet new needs.

The production of light and the control of light received all the attention practically up until very recent years. But those are just means to an end. They are no more important than the power plant, the wiring, the distribution system, or the conduits. The production of light and the control of light are merely visible links in the whole chain, from the power plant to the human being. Those are engineering phases because they have dealt with physical sciences and practically all the thought and development in lighting has been in that link, or in regard to those two links. In other words, lighting engineering was all dressed up and didn't know where it was going!

The third link in the chain is the utilization of light, the specification of light. Twenty-six years ago when we started in our Lighting Research Laboratory, it had to grow like other things. We could see that the bottleneck was the knowledge or the lack of knowledge of the utilization of light, and we set for ourselves the task of finding out what light could do for human beings. That, we felt, was our real product. Our real product wasn't lamps. Our real product wasn't kilowatt-hours. The real product is the human product. What can electric light or electric energy do for human beings? I consider the best measure of any activity is that which is measured in terms of contribution to the welfare and happiness of people. If our business, our profession, our activity doesn't finally contribute, it isn't a very good business to be in.

Looking over lighting, these were all the links, some beautifully developed. Nobody can say anything against the fine engineering and scientific achievement from the power plant to the people, but there was no development of that third link—the specification or utilization of light. The human being and the humanitarian element, with few exceptions, did not enter into lighting.

I think of a story, a part of which Believe-It-Or-Not Ripley tells. He is always looking for the odd things. It occurred to him that over in Asia there were a lot of Chinamen. He looked up statistics one time to see how many Chinamen were in the world. He found there was no definite census of the Chinese in the world, so he started asking people who were

travelling how many Chinamen were in the world. He was getting estimates from people who really ought to know something about the number of Chinese in the world, and he said the most prevalent answer he got was, "There are entirely too many." But he persisted and persisted and finally he put together all the best estimates and came to the conclusion that there are about six hundred million Chinese in the world. So, to make it more startling, he said if they were placed four abreast and marched past a given point in regular military marching order, they would never pass this point. Which is a difficult Believe-It-Or-Not idea or conception. The reason they wouldn't get past this point is because marching according to regular military marching order, four abreast, only twenty-nine million can pass this point in a year and there are thirty-two million Chinese born every year.

That is all very fine and it explains beautifully all the engineering conceptions, of course, but how could thirty-two million Chinese be born every year if they were marching all the time?

There is an analogous situation in lighting over the years. When I say this I am not minimizing the contribution of the engineers' effort. The engineers or the lighting specialists did what they could with what knowledge they had, but the link that was undeveloped was that link which connected human beings and told them what light and lighting can do for them.

It is very obvious why our knowledge of the human being lags behind our knowledge of physical things. The human being's activity is a very much more complex thing than a distant star or earth or physical body. So we started out with the idea of making light or satisfactory lighting a science rather than a system that was practised by opening a catalogue, pointing to a fixture, and saying, "Use 200-watt lamps on 10-foot centers. That is the kind of lighting you need."

That is all the engineer can do without knowledge. There is plenty more than that. That doesn't connect a human being in any important way and the specifications were weak because they weren't founded upon any sound basis.

We began to go back to the beginning. We said, "We are children of Nature. We have just come indoors. Let's look at the brightness we have outdoors and begin to make measurements." And there is the science of measurement. We discovered obvious facts and then discovered obvious connections between facts that had been inobvious. We found that there was 10,000 times more light outdoors than in the interiors men had built in their ignorance with a little bit of knowledge. Then, we have bright lights corresponding to a hundred footcandles on a page of a book in our library, yet we are dealing with one footcandles or five footcandles. It began to draw upon the great principles of adaptation and environment, principles accepted throughout the complex sciences of biology, accepted by every scientific man in every respect whatsoever, until we come to vision, and human seeing-machines and

seeing. I could mention a thousand details to prove that we are made for Nature's light and Nature's brightness and Nature's lighting. Yet, we come indoors, away from the hundreds of thousands of footcandles and those enormous brightnesses and build a world in our ignorance and not even wonder what penalties we may be paying.

The old idea was based on barely seeing. If we could see or barely see that was enough. Unfortunately, eyes developed that were able to see in emergencies at very low intensities and also see at the normal intensities of illumination outside under which we evolved. Then, science began to come into the world. A long while ago it was born in a vague way. It didn't come forward definitely until recently. The science of vision developed; that is where we started in our work, having light as a partner to vision. It wasn't many years until we began to find out that the science of vision couldn't tell anything about what light could do for human beings because the whole science of vision is predicated on the minimum light necessary, the minimum contraction necessary, and so forth.

We began to think again about optima, that the object of promoting or linking an aid to seeing isn't to supply the least amount. We don't supply the least amount of the worst food we can get by with. Our object is to supply the optimum conditions in any respect, the optimum conditions which are the best for people. The science of vision gave us no knowledge of optima.

Then, another rut developed and all of us got into the rut of vision. Then, another rut came along as civilization advanced and began to develop light sources artificially. Flames of that sort had one candlepower, roughly. Did you ever stop to think what would be the situation in this lighting business today in the indoor world by day and night, or in the outdoor world at night, if our first artificial light hadn't been one candlepower, but by accident had been a hundred and one candle power? The first incandescent lamp wouldn't have been three or four candle power, but a thousand, to attract any attention as a lighting tool.

We begin to look around at other penalties we might pay, not dealing with them at all from a scientific standpoint. The penalties have to be obvious. Let's see if there are any.

The first is eye-defectiveness. You don't have to search far for eye-defectiveness and the prevalence of it, as you see children progressing through school without coming to the conclusion, and it is a fairly safe one, that it must be a plague of civilization. It is certainly not anything natural.

Now, we begin to approach in many different directions to the proving of the point that eye-defectiveness is a penalty or a plague of civilization. Then, go back and think about science and what science's job was. It is not to start right where we leave off, necessarily, with vision and light, but sometimes science has to go away back and start all over. To begin with, we have to think of Galileo. He is really the father of modern science that started only two or three centuries ago. As we come up the line,

thinking very quickly, we visualize a hundred years ago this decade, Michael Faraday, for the first time in all history making the simple, crude experiment which revealed the laws of electro-magnetism and showed how to convert an unlimited supply of mechanical energy into a new thing we call electrical energy. That was only a hundred years ago.

We began to realize that we do not have to know everything now, and there was not a chance in the world of knowing very much. The great chances were there was an enormous amount to be discovered, and it is just another way of presenting that platitude, that our greatest assets are the things we don't know.

So, we began to think about science, itself. The objective of science was what? To discover obvious facts. That is why science was born. It was born when thinking men came to the realization that their own senses couldn't discover everything, that their own senses were very much limited, and the real knowledge lay beneath and beyond the ability of those senses. Then modern scientific methods started and jumped quickly to the fore with this analysis.

We have just finished eating food. There are six or seven hundred stomachs represented here, all with a great line of ancestral stomachs and all those stomachs combined, including yours and mine, never discovered a vital factor of food, never suspected the existence of a vitamin, never suspected the far-reaching effect of food. This is a very important thing. Everybody connected with the world of seeing thinks the eyes can tell something about seeing. They cannot tell the slightest thing about seeing, any more than a stomach can about food.

Suppose you and I went on the highway. Suppose we took a drive and happened to come to a place where there was a wrecked car and a fellow was just crawling out of it, and I got out of our car and went up to him and said, "Hereafter, Fellow, you will eat your carrots that you have been kind of cheating on", you would say I was just plain crazy. But I know that carrots produce Vitamin A. That was an unobvious fact not long ago. Vitamin A was not discovered until about twenty years ago—in this century. It was an unobvious fact until then. Then it took a good many years before it was definitely found that there was such a deficiency of sight, called night blindness. Only a few of us were found to have it. The unobvious thing, essentially, was that a deficiency in Vitamin A is responsible for night blindness, or the lack of ability to see brightnesses as low as the average person can see.

Now, we have an unobvious correlation. In the last two years in the hospitals a deficiency of this Vitamin A has been determined by means of photometers of light, by means of one or two or three footcandles. We wouldn't believe that we were paying human penalties besides the obvious penalty of eye-defects. As long as we pursued the study of vision we were never ascertaining anything beyond vision and we never find anything about light, except the minimum of light you can barely see by. It took new conceptions of knowledge and these are examples now. They have

their troubles and we have trouble giving birth to them. It takes a long time to clarify them.

We began to think about the seeing side of vision. Seeing isn't something we do with eyes and light. Seeing is something we do as human beings. Seeing is something we do with our bodies and minds, We do seeing with our nerves, energy, heart, muscles, body, mind, every part of us.

In other words, we theoretically created the conception that we are human seeing machines and we have had a very hard time over the course of about sixteen years of getting our own thinking over the hump of vision, beyond eyes, and getting the thinking of others beyond eyes, even the eye-man himself.

Speaking of the eye-man, he does a good job. He has taken care of that, too, as far as office and refractory methods are concerned but he lets the tool go out to be redamaged. Now we have particularly talked to them over the course of about eighteen years and we have in the United States today 25,000 eyesight specialists that are ready and are beginning to try to do their part in promoting better seeing.

So, we develop that conception of seeing. No more was it minimum light we were concerned with. We were trying to invade the human being and we tried to find out what penalties a human being was paying, doing this job of seeing as an unnatural task of civilization carried on under amounts of light one thousandth and one ten thousandth of the amount we had evolved under out-of-doors.

Now, we began to study, thinking toward what we call optima of light that we would be required to use, not minima of light, which means penalties.

Then, we began to study the effects of seeing. It is a long complex job taking a human being apart and finding out where there are any effects of seeing in that human being. We didn't carry on only with light. The whole science of seeing has to be developed on a broad front because there are many factors involved and they all stick together. Light is one of them or, to be more accurate, brightness. We began to study things of this sort, such as eye fatigue. It had been talked about for years, and science had attempted to measure the fatigue of eye muscles. For the first time in an accurate way, it was related specifically to the aids to seeing, such as light and brightness and other factors.

Now, we know positively that we can read a book, well-printed, large type in the moonlight, but if we read under a hundred footcandles the muscles of the eyes are only one-third as fatigued under an hour's reading as if we read under one footcandle.

I can enumerate many examples but I am using only examples that are very direct. There are many others that are indirect and that take a good deal of time to describe. They all point to the same thing. In our researches as a rule we stop at one hundred footcandles. On white paper that corresponds to a thousand footcandles out-of-doors, on ground, lawn, wood, pasture or earth areas, paper being white.

Take our waste of muscular energy. We have been able to measure a de-

crease of waste of energy, or the utilization of energy in the task of seeing as we increase intensity of illumination in footcandles up to a hundred and above.

Take the heart rate. It is an absolutely established fact that after an hour's reading under one footcandle, each of a group of normal people, averaging about 28 years in age, showed that their heart beat dropped eight beats. After reading an hour under a hundred footcandles, the drop was only two beats. A million heart beats went into this, automatically recorded over a course of months with quite a group of normal subjects. We don't know what this means. Some of the other things we do know. We know that a waste of energy means fatigue. Muscular fatigue includes the possibility of permanent eye defect. We don't know what are the results of seeing not only with our eyes and light but with the entire human being, all parts of us. We should get these results.

I don't often mention this in a public room because sometimes it is distorted. Let me give an idea of what happens when this kind of fact gets in the thoughts of other people, when this kind of material is published in the scientific journals. A paper was prepared for the American Journal of Ophthalmology. An Ophthalmologist comes and says, "I can remember now where I had a bad reading light and I have a heart condition myself. I never thought of measuring the light I used." Measurement of light never occurred to him. It is just beginning to creep in and we have to have the tools to measure light with, and that tool ought to be distributed in our country and your country by the millions. We don't know anything about light until we measure it.

Here is the first device manufactured to measure seeing conditions in a world built on something in which eye efficiency is a factor and on which about half the welfare, happiness, life and health of people depends. It is the first device developed to measure seeing conditions simply.

Let's pursue the heart thing a little further. The work was probably published three years ago. A month ago an individual connected with the United States Bureau of Public Health wrote me that it had come to his attention for the first time. He said, "A year ago I completed a study for the United States Bureau of Public Health of forty-nine industries, non-hazardous industries, involving 59,000 employees, where we very carefully went back for five years and determined the causes of natural death and correlated with the occupations of these people." He said, "It was done a year ago. We found that of the people in non-hazardous industries who were engaged in precision work, and died, eighty per cent. died of heart trouble, heart failure . . ." Maybe there isn't anything in the correlation, but that is how science grows. Here is the fact of the heart rate. You can expand that. There begins to be a correlation. I mean it when I say there are hidden plagues. It is always safer to figure there are hidden plagues because there is enormously more hidden from us than we know. Plagues, hidden things, not the obvious things.

We never got anywhere in lighting, we never got anywhere in seeing as long as we dealt with the obvious. That is true of all civilization. We would never have discovered electricity a hundred years ago or three hundred years ago if we had trusted to the human senses. There isn't a human sense exists that can detect the presence of electricity. All you detect is the effect. We are very, very limited.

Now, I have talked about penalties and I could go on by the hour and talk about penalties. We have already revealed or half revealed our suspicions and in the Better Light, Better Sight Movement these things have gone on and this kind of knowledge has necessarily and perfectly satisfactorily dealt with penalties to begin with.

But the big, far-reaching thing is the reward, not the penalty. I think of a story that maybe emphasizes the undesirability of too much emphasis. A girl went to a hospital one day, rather hurriedly for an emergency operation for appendicitis. She was taken in in the afternoon. Of course, there had to be a nurse who came in and washed her face and then went out. Another nurse came in, pulled up her nightie and sterilized her upper arm, ready to give a "shot". Another nurse came in and gave a "shot". Still another nurse came in and pulled up her nightie in another place and sterilized her abdomen. The girl began to get nervous. Finally, in came a woman with a pail and a mop and the girl said, "What are you going to do?" She said, "I am going to scrub your transom."

Too much service for that girl, too much emphasis. So there is a limit to the emphasizing of the penalty.

Now, we do have opportunity to emphasize the reward. What I think of is that in the lighting business you are lighting specialists. I wouldn't say it is a lighting profession because we don't have a lighting profession here today, with the exception of a very few individuals in it. We have something that just grew in empirical days in the empirical art of lighting. We don't have the professional attitude. That is the biggest job that lies before the lighting business today, to develop a lighting profession that has behind it the science that is involved, a science that has a real purpose, the real beginning of light and the real end. It will never make it by itself. Let us take the analogy of the doctor. A hundred years ago science was in its crude beginnings as far as services to human beings were concerned. Go back one hundred years and you will find the medical profession was not a profession, not on its own account because there wasn't a science behind it to make it a profession. Go back and think of things, go back and look at statistics. I opened a book the other day to see the causes of death in London, only 150 years ago. I went down the line, three of this and four of that and six of this and two of something else, and finally down at the bottom it said, "plagues, 76,000". Now, we have eliminated that kind of plague. Science is behind the doctor. He isn't science, he is an ambassador of science. He takes the dictates of science which determines his diagnosis and his treatment and he goes

out with the confidence and the knowledge of science behind him and he serves. One hundred years ago he wasn't even tolerated, he was ridiculed. Then, he became tolerated and today he is demanded. And I would like to say, if you sit in a doctor's office this afternoon, choose any doctor, and you will probably find people coming, or telephoning, "Doctor, come quick." Does that mean a frantic mother with a sick child? Specifically, it is something bigger than that. It means the doctor has sold himself to the public and he is desired and demanded and what he has done is the result of science behind him and the confidence and courage the scientists have given him. The professional research and the human attitude of that doctor goes out and serves the public.

Some of you may be thinking some doctors are not so hot. There are as many poor doctors as poor lawyers, but the worst doctor is a blessing to civilization and the best doctor is a superman. That is the kind of thinking I like to feel is coming into the lighting business. We have something that touches more activity and touches human beings more than any other voluntary thing they do or man-made thing they can have. Outside of breathing it is more important than anything I can think of and breathing is a voluntary or man-made thing.

We can go up and down the line. I can prove from that angle and this angle, five different approaches. I can prove to you that somewhere in the neighbourhood of 300 or 500 footcandles is the best intensity of illumination under which to read a book, you can read in the moonlight. It has not all been definitely proved. We have arrived at the point where we have proof of the necessity for 100 and 200 and 300 and 500 footcandles for the common task of reading, and even five hundred footcandles for the moment are on the defensive for the first time in the development of lighting through a science of seeing. I could take you, if there were time, through several different angles and prove that to you.

When I say reading you may remember that is the easiest task of civilization. There are many tasks of inspection, on which we will not talk of 200 and 300 footcandles, but on which 1,000 and 5,000 footcandles are the optimum and the ideal.

What has happened in the complete course of the picture, from the various approaches? What are we finding out? Just the thing we should have accepted long ago, that we are children of nature and we are designed for the light and the lighting of outdoors. We can go through the schools, through the homes and in the homes what happens? Already, with just one per cent. of this new knowledge getting into the lighting field and into the lighting thinking, the lighting business has gone forward over the whole world. It has accomplished in the last several years what it never did in all its existence. It was just selling something before, knowing vaguely it ought to sell more light than was in existence, not having science behind it. In the home field today we have three thousand home lighting advisors, put into the utilities in the last two years. They are out selling, they are ambassadors

of science, developing an opportunity for the business that pays them and that they have a right to develop a profit for. In the home field three or four years ago a 100-watt lamp was unheard of. When we commenced knowing these things long ago we began to think about our people. At that time anybody would be shocked at the thought of 300 watts. Just yesterday I called up to see how many 300-watt lamps had entered into the homes in the United States last year, and they told me that 770,000 of them had been purchased. That has all happened in the last two or three years. Why? A science behind us today, a semblance of scientific knowledge gives confidence and courage to go out and make recommendations in the highway field. There are certain tangible things. We can get down to the cost, in property, lives and so on. Science is behind us for the time and devices for measuring lighting conditions are such that we know what we ought to do on the highways now and we started last year in the United States to put 50,000 miles of lighting on the super-highways of the country.

That is true as you go down the line, in the home field, in the school field, in the industrial field, on the highways. Humanitarian light and lighting can be obtained at no cost from the saving of penalties, and the rewards are gotten free.

The world fourteen years ago had already a great deal of knowledge pertaining to production as effected by lumination or footcandles. We all know that careful tests revealed that our ability to work and produce increased with the footcandles but, generally, most of the benefit seemed to be about the time we got to 20 or 30 footcandles. It was generally done at the cost of a very small part of the pay-roll, eight or ten per cent. net production, after paying for the light produced.

We said fourteen years ago. Let us take that per cent. increase in production we get for nothing and buy hundreds of footcandles, buy humanitarian footcandles. We understand the penalties, we don't know all by any means. We understand something of the rewards. We can light this world, our homes, our schools, our work world, our highways, for the net saving in penalties, without counting human losses. In other words, let us go back to Faraday, a hundred years ago, cutting the magnetic field. I think of him back there as a young fellow working, about twenty-six or twenty-seven years old. I imagine him working in his laboratory there in Cambridge and he is doing a great work in building the foundation of all this. Those experiments produced the means toward an end.

In thinking about that I happened to think, as I was reading the biography of Goethe, that Goethe had influenced the world in many ways. Somehow, it flashed through my mind that as Goethe lay on his death-bed over there, here was young Faraday, carrying on, in some ways, where Goethe left off. The last lines were something like this: Goethe was lying on his death-bed, the dim light was fading. He asked his daughter to go to the window and raise the shades, murmuring, "More light, more light",

and I, in a fantasy, thought that was a command sent across the channel to young Faraday in his work-shop in Cambridge and he did produce the means. We have been a hundred years finding something about the real end.

I leave you with this thought. We all have money to make. That is something that supports business. I never hesitate about the commercial side of a business, a business that is contributing to the welfare and happiness and efficiency of people. A man has a right to have a profit on that business—in spite of a lot of talk to the contrary. So you have to sell something and everybody has to buy something. We don't bother about that. There is always money involved, there is always the commercial promotion. All I ask is that we get behind all that knowledge of the scientists that are back of us, to give us courage to do a better job for people. Finally we will end up with this individual and business idea, that your pay isn't all in money. It is partly in satisfaction.

Maybe you have heard this story. I like this one. Three men were cutting stone in a stone quarry and one day a visitor came up and asked one of them what he was doing. He said, "I am working for $5.00 a day." He asked the second man, "What are you doing?" He said, "I am cutting stone, according to the specification." He asked a third, "What are you doing?" This fellow took time to look up and with pride in his voice, he answered, "I am helping to build a cathedral."

Domestic Wiring

By James Paul Warner, Consulting Electrical Engineer, Mellon Institute, Pittsburgh, Pa.

(Presented to Association of Municipal Electrical Utilities at Toronto, February 2nd, 1937.)

WHEN your invitation to read a paper on Domestic Wiring came to me, I immediately dismissed any thought of discussing codes or regulations, for it is well known that your requirements are higher than those with which I am familiar. Your codes and regulations are your minimum requirements and have been built up by the general acceptance of that which is good from all that was developed by the industry leaders.

Our early standards both of safety and adequacy were low. I well remember when standard practice called for one ceiling outlet and one switch in any room. Many houses were wired to this standard. The manufacturers later offered irons, toasters, percolators and other electric devices and the advertisements stated that they could be connected to any socket. Some people bought them, but after they burned off fixture wire, shells came off sockets, or they tired of climbing on

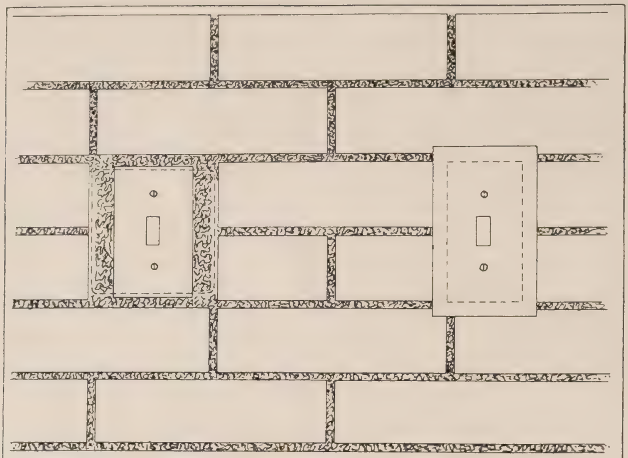


FIGURE 1

ELEVATION STANDARD BOX & PLATE

ELEVATION SPECIAL BOX & PLATE

the dining room table to make connections they were laid aside and not used. Their friends heard of the difficulty and the sales resistance went up and the utilities lost the load they thought they had acquired. The industry then became conscious that inadequate domestic wiring was hindering the development of their business. The trade papers, utilities, and electric leagues talked adequate wiring. Then appeared standard requirements with a red seal as a badge of merit for compliance. This work went on for several years but still our houses are not adequately wired. The lighting industry recently realized that their products were meeting with sales resistance on account of inadequate wiring and a Handbook of Interior Wiring Design is being prepared by the Illuminating Engineering Society. In this book they have devoted a large section to residence wiring with typical and specimen specifications.

The work of the industry through the years has not yet produced a general acceptance of adequate domestic wiring with which any of us are satisfied. Who then shall carry on to put in our homes the facilities through which kilowatts may be delivered and transformed into convenience and comfort for our people? I like to think of the responsibility as being divided among the various groups of the industry as the responsibility for public health is divided among many groups.

The position of the engineer might be thought of as analogous to that of the doctor. The engineer studies his clients' requirements and writes a specification for his wiring needs in a manner similar to that used by the doctor in diagnosing his patients' ailments and writing a prescription for them. Unfortunately only a small

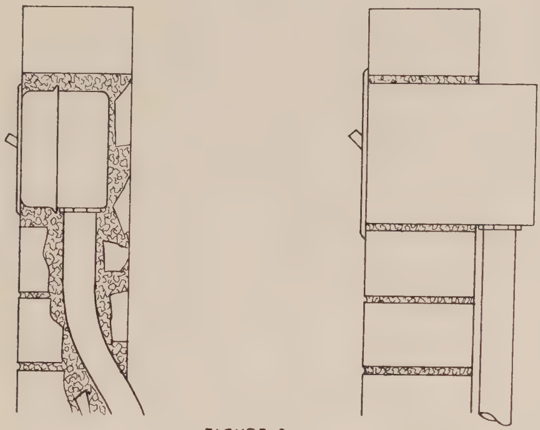


FIGURE 2

SECTION
STANDARD BOX & PLATE

SECTION
SPECIAL BOX & PLATE

percentage of domestic buildings receive this specialized attention.

Fire insurance companies are interested in wiring in a manner somewhat analogous to the way life insurance companies are interested in public health. It is a dollars and cents interest.

The utilities, electrical manufacturers, wholesalers, dealers, and contractors are interested in wiring in a manner similar to the interest food and drug manufacturers and merchants have in public health. This interest is one of an expanding market.

The public and the state are interested in both wiring and public health. Otherwise, there would be no wiring regulations or public health laws.

These analogies may help to bring out the fact that the responsibility rests with all of us in the industry to contribute our part in promoting adequate domestic wiring, whether we belong to the classification of engineers, utilities, manufacturers, wholesalers, dealers or contractors.

How to promote the idea of adequate domestic wiring is now the important question. The answer I will leave to some one wiser than I, but I do know that it is largely a matter of propaganda, first among ourselves and then to the public. Each industry group should lend a hand not only where there is an opportunity, but wherever an opportunity can be made.

Some of us may not be interested in promotion, but all of you are interested in some way in adequate domestic wiring. To you and to those who are asking for concrete ideas that may be applied to the daily task of designing or wiring houses, I offer a few detached solutions to various wiring problems that I have encountered.

The development of the thermal breaker for branch circuit protection offers a tamper proof and convenient device that is applicable to all kinds

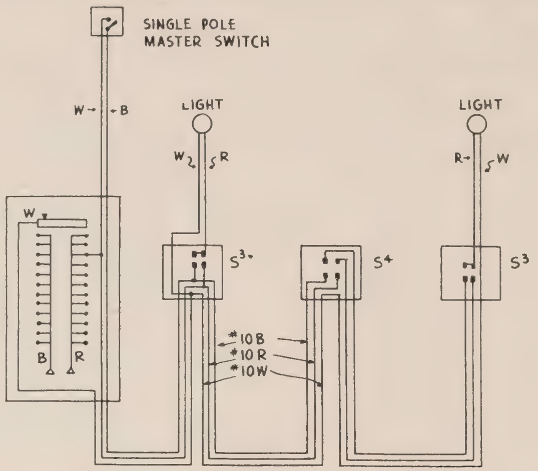


FIGURE 3 – WIRING SCHEME OF MASTER CONTROL SYSTEM FOR USE ON INSIDE OR OUTSIDE LIGHTS

of residences from the smallest summer cottage to the largest and most complete house. Its acceptance has been limited on account of the cost, but with a lower priced unit which will soon be available, I believe many will show a decided preference for them on account of their greater convenience and safety.

The location of panels or distribution centers in large houses with twenty or more circuits, requires careful study of the plans. Many of the new houses are low and spread out. In this type of house two and sometimes three panels are required to keep the branch circuits from becoming excessively long. The panel locations must be chosen with reference to the construction so that conduits or flexible armored cable may readily be installed into top and bottom without cutting a chase in a bearing wall under a beam or digging into the masonry surrounding a flue or fireplace. Sometimes best locations are found on the first floor but more often a basement location is preferred. For the smaller houses, it is generally preferable to locate the distribution panel in the kitchen directly behind the meter which is on the outside.

With the increased use of interior walls of brick, structural tile, and terra cotta, the selection of the proper type outlet box becomes a problem. In general there are no standard boxes suitable for these conditions, and special boxes of a height equal to one or more courses of the material should be used. Boxes should be deep enough to accommodate conduits back of brick, tile, or terra cotta without cutting and should accommodate one or more rows of devices with standard spacing.

In living rooms and bed rooms with several duplex plug receptacles for floor lamps, it is convenient to control one of the two receptacles in each out-

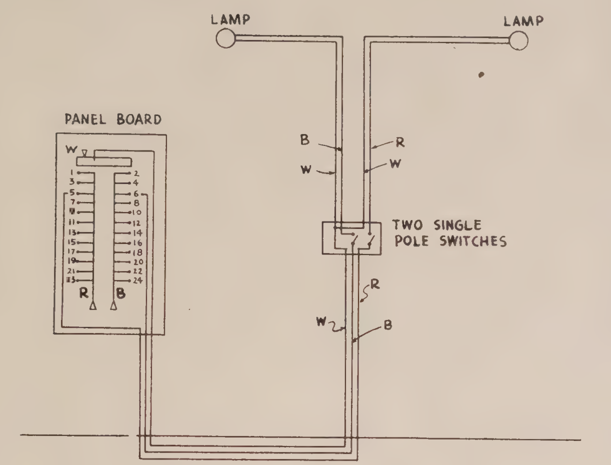


FIGURE 4 - WIRING SCHEME USING COMMON NEUTRAL FOR TWO CIRCUITS ON A 115-230V SINGLE PHASE THREE WIRE SYSTEM

let by one or more switches so that if lamps are attached to the controlled side of the receptacle they may be thrown on at the door entrance without going around the room and pulling chains or turning keys.

Plug receptacles for picture lights are desired by some owners. Where to locate them is always a guess, in general the owner does not know the size picture he will purchase or which one of his present collection he will hang in any particular location. Plug receptacle outlets for pictures should always be switched.

The people who are accustomed to street lighting at night want something to replace it on their estates when they live in a suburban district. Private road lighting is sometimes used, but the usual answer is to install a single pole master switch in master's bed-room that throws on all outside lights. Normal control of these lights is had by three-way switches, if from one point, and by a three-way and four-way switch used for two local points of control, with an additional four-way switch for each additional point of control. The same system is often used for central hall, stair, and passage lights on the inside of the house.

Exterior weatherproof receptacles are desirable for open porches, patios or terraces. They form a convenient means of connecting Christmas tree, canopy, or festoon lighting.

Number 12 wire offers many advantages over number 14 for residence wiring, the chief one being that the drop in voltage is only two-thirds as much as if number 14 were used. There are always some circuits that could properly be number 14 wire, but there is danger when any number 14 wire is available on the job that someone will use it in the wrong place.

A common neutral can be run for two circuits on a 115-230 volt, three

wire, single phase system. The use of this wiring scheme requires care on the part of the electrician. Specifications on this point may be made to read, "A common neutral shall be used for an odd-numbered circuit, and the even-numbered circuit following, i.e., circuits lying opposite each other on the panel, when both are contained in same conduit or armor," To keep circuits readily distinguished for conduit jobs, specifications may read: "All wires connected to left hand side of panel (odd-numbered circuits) shall be black and all wires connected to right hand side of panel (even-numbered circuits) shall be red." If armored cable is used and two wire circuits are connected to right hand side, the wording has to be changed to provide for black wires of 2-wire circuits on right hand side.

Good engineering calls for spare circuits on the panel or panels. Twenty percent spares is a reasonable figure although studied conditions will indicate exactly how many should be provided. If no provision is made for making these spare circuits accessible when a panel is installed on a finished wall, they are of little or no value. If panel is flush type in finished wall, spare conduit or flexible armored conductor carried to a junction box in attic or basement or both makes the spare circuits available for future use.

Some of the special circuits required for adequate wiring are:

- 1 circuit for refrigerator.
- 1 circuit for washing machine with pendant receptacle.
- 1 circuit for electric ironer connected with number 10 wire to a 20 ampere receptacle.
- 1 circuit for each 1,500 w. bath heater connected with number 10 wire.
- 1 circuit for each hand iron outlet with switch and pilot light on the wall and pendant receptacle suspended from ceiling.

Butler's pantry and work space in kitchen call for some special circuits terminating in receptacles. Sometimes one circuit is required for each receptacle and sometimes three or four may be placed on one circuit.

In rooms such as drawing and living rooms, dining rooms, and bed rooms, it is best practice to take all home runs out of switch box for the room. If this is done, change of control is easily accomplished by working in only one box.

In general, it is best practice to keep plug receptacle and lighting outlets on separate circuits. Care must be used in numbering circuits on three wire panels to avoid the unbalance that would probably result from keeping light circuits on one side and plug receptacle and appliance circuits on the other.

O. M. E. A.—A. M. E. U. : Convention at Niagara Falls, Ont., June 28, 29 and 30, 1937

The Utilities' Interest in Shunt Capacitors

By Hugh Rose, Commercial Engineer on Capacitors, Canadian General Electric Company, Limited

(Presented to Association of Municipal Electrical Utilities at Toronto, February 2, 1937.)

Utility executives and engineers are faced with problems of economic distribution created by the increasing demand for power. Further, the quality of service, a most important factor in the sale of electric energy, is greatly influenced by the increased loading on distribution feeders. Good service is as essential to progress in the field of electric distribution as in any other enterprise. Hence it is, the negative effects of large reactive loads on distribution circuits are becoming more and more obvious. Fortunately, in recent years, the evolution of the capacitor from a laboratory device to a reliable commercial equipment, offers a solution of the economic and some of the technical problems of distribution, which have arisen. It is our purpose to point out some of the benefits which result from the use of shunt capacitors on distribution systems and to mention some of the outstanding features of the modern pyranol-filled, unit type shunt capacitor.

THE world is entering on an era in which electricity will progressively eliminate human drudgery. The opinion was expressed, by those who presented papers at the World Power Conference in Washington in September of last year, that the consumption of electricity will increase as rapidly during the next fifteen years as it has during the past fifteen. This will result in virtually doubling the present use of electric power. What does this mean to you, the executives of our Hydro utilities, who are in immediate contact with the consuming public? The consumers' attitude is an important influence in the extension of electric service and your action on the problems of distribution can either help or hinder the fulfilment of this prediction, insofar as Ontario is concerned.

The problems involved in the distribution and utilization of electric energy are many. No two systems are exactly alike. Although all of the Ontario Hydro utility commissions rely entirely upon power purchased from the Hydro-Electric Power Commission, yet some systems are 25 cycles, others 60 cycles, some serve high density areas, others low density and others a combination of the two. Some are located in districts where natural gas is abundant and therefore have a serious competitive situation to handle. Thus each system presents its own peculiar problems. However, all are concerned with the final delivery of electric energy to the consumer and the main problems of distribution are common to all.

The object of the utility management is to provide constant power at an adequate voltage and at the least cost to the consumer. The benefits to all of constant power are self-evident, and the advantages, both to the user and to the utility, of applying the proper voltage, have been clearly brought out in technical publications, whereas the matter of cost comprehends both constant power and proper voltage control. Therefore, in pursuit of the utilities' objective, no problem seems to be more serious than that of avoiding improper utilization of equipment and inefficient distribution.

The steady increase in the kilowatt-hour load curve has attracted wide-spread attention and has focused interest on distribution problems. It is being recognized that since the investment in the distribution system is roughly 40 per cent. of the total investment in electric plant, and in your case actually 100 per cent. of your investment, it must be utilized efficiently and any improvements which may be made here are most desirable.

A large part of the cost of delivering power to consumers supplied by the distribution system is due to fixed charges on investment in the system itself, to the losses which occur in the system, and to the transmitting of these losses. Although progress is continually being made, yet it does not appear at the moment that any material reduction may be made in the cost of the component parts of which distribution systems are made, such as substations, transformers and feeders. Lowered costs must depend, therefore, upon increased and more efficient use of existing facilities.

One of the problems facing utility executives to-day is that of taking care of the increasing load on existing distribution systems. On short feeders, additional loading is limited by copper losses. The reduction of reactive current will reduce these losses and thus enable further load to be added to existing lines. On longer feeders, voltage drop usually is found to be the limiting factor. Here again the reduction of the reactive component will decrease the voltage drop and allow additional load to be carried.

POWER FACTOR CORRECTION

Power factor correction is one of the principal sources of improvement in the efficiency of electric distribution. The losses entailed in the use of electric energy at low power factor have been recognized for years. The introduction of a.c. power loads on the feeders of the early lighting companies necessitated consideration of inductance along with the other fundamentals, volts, amperes and resistance. However, very little was done to offset the negative or destructive effects of the reactive load until within recent years, and only now are distribution engineers beginning to fully realize the benefits which result from the control of this factor on distribution systems. Recent surveys indicate that although there is persistent load growth, yet the system power factor curve tends downward. These two factors, load growth and low power factor, are forcing serious consideration of the maximum load limitations on many systems. If this problem is of importance anywhere in

Canada, and it is, it is much more so here in Ontario, where are located the major industrial developments of the country.

Although operating engineers are aware of the bad effects associated with low power factor yet they sometimes fail to fully appreciate the magnitude of the benefits to be derived from power factor improvement. Some years ago a well-known power company of Western Canada made a thorough study of the economies connected with power factor correction on their system. After determining the savings that could be effected in copper outlay should the power factor be raised to 90 per cent. (the existing system power factor was 82 per cent.) they purchased five capacitors for experimental purposes. These were installed on some of the most heavily loaded feeders of low power factor. The results obtained in reducing the current in these feeders were very gratifying and stimulated effort to go still further into the matter from their customers' standpoint and a number of customer-owned capacitor installations were made. The tangible effects are interesting. As a direct result, during the year following the completion of the program, 11,700,000 kilowatt-hours were made available for sale that would otherwise have been dissipated as heat. The company estimated its annual savings to be well over $100,000 and in addition the improvement obviated the necessity for additional generating capacity which former conditions had indicated was required.

During the lean years, with the general dropping off of industrial load, the power factor problem may have meant little to the power distributors, but this is no longer the case. The reawakening of industrial activity, coupled with the growth in domestic load, which was well maintained throughout the depression and which is being augmented by the increasing use of motors for air-conditioning in the home, are all factors in crowding existing feeders to capacity and the demand is increasing. Capacity is needed but this does not necessarily mean additional generating and distribution equipment. (One authority ventured the opinion that at least 30 per cent. of the present loading is reactive or wattless power.) In many cases the utilities can avoid the installation of added transformer capacity and heavier or more feeders, by a careful study of the economies of adding capacity by unloading the wattless power from their lines. Therefore, an inexpensive and quickly applied method of adding capacity is provided by power factor correction.

Effect of Power Factor Correction on Line Losses

The efficiency of a distribution feeder, unlike that of a motor, is a maximum at minimum load and decreases as the load increases. Resistance losses, for example, are a maximum at peak load and add directly to the peak. Losses also have to be transmitted and themselves give rise to losses. It is well, therefore, to keep in mind that the reduction of system losses at peak load is equivalent to increasing the capacity of the system by the amount of such reduction or in the case of purchased power the peak is lowered by the same

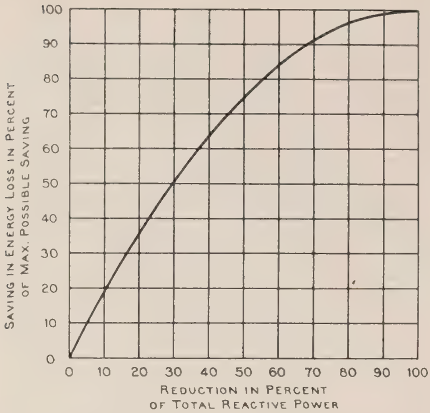


Fig. No. 1—Per cent. reduction in energy losses in relation to per cent. change in reactive power.

amount and hence the power bill is lowered.

The improvement in voltage and reduction in copper losses which result from power factor improvement, even on a single feeder are quite substantial. This fact is clearly indicated by the curve of Fig. 1. Unity power factor is a condition devoutly to be desired but is seldom, if ever, realized on a feeder. Even under such conditions there would still be copper losses but such losses would be a minimum for that line. The maximum saving in line loss would be realized by correcting the power factor to the ideal conditions of unity. In Fig. 1 the saving in line loss, in per cent. of maximum possible saving, is plotted against the per cent. reactive power present. Thus if the reactive kv-a. were reduced 30 per cent., the saving in losses would be 50 per cent. of the maximum possible. Such a reduction in reactive kv-a. would result from raising the power factor from 60 per cent. to 73 per cent., hence a comparatively small increase in power factor, appreciably reduces the losses.

This same thought is brought out in Fig. 2, which shows the magnitude of power loss savings in various general instances. The losses in a feeder are directly proportional to the square of the current. The current for a given kilowatt load varies inversely with the power factor, hence the losses vary inversely with the square of the power factor. For instance, the current at 80 per cent. may be 200 amperes. At unity, the current for the same kilowatt load would be 160 amperes and the losses would be in the proportion 200^2 to 160^2 or 100^2 to 80^2. In other words, the losses are reduced at unity, to 64 per cent. of the value at 80 per cent. power factor. Referring to Fig. 2, the loss under any assumed new power factor conditions, expressed as a percentage of the loss under the original power factor conditions, can be read directly. Thus a load at 60 per cent. power factor would have only 50 per cent. as much loss if the power factor were improved to 85 per cent. It is evident,

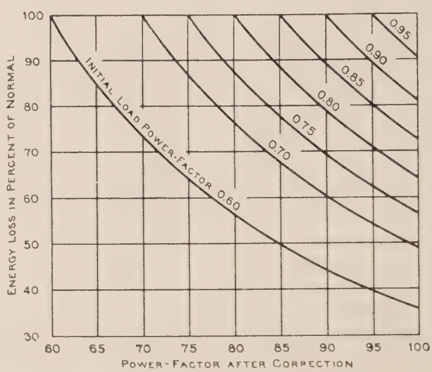


Fig. No. 2—Per cent. reduction in energy losses effected by power factor correction.

therefore, that a high power factor is desirable from the feeder loss standpoint alone. Also, in passing, it may be noted that the reduction in load current will affect the voltage drop. For example, in the case mentioned above, the reduction of current from 200 to 160 amperes results in a 20 per cent. improvement in voltage drop, which is also an important factor associated with power factor correction.

EFFECT OF POWER FACTOR ON VOLTAGE DROP

Voltage regulation is a subject of paramount importance to utility engineers who are continually faced with the necessity of improving voltage conditions. This is usually accomplished by the use of regulators or the line characteristics may be modified by increasing the copper size. Distribution engineers are now studying the effect of power factor on voltage drop and as a result are applying shunt capacitors to this problem with most excellent results both from the technical and economical standpoints.

The trend in the electrical industry in recent years has been toward the use of static devices, wherever they can possibly be applied, in preference to the usual conventional apparatus, which depend upon mechanical motion for their operation. The reasons for such a trend are greater efficiency, minimum noise, lower maintenance, minimum attendance, economy and greater reliability. Therefore, it is not surprising to find that the capacitor is coming into greater and greater use as a power factor corrective device on distribution systems.

Until recently, the object usually in view in the application of a shunt capacitor has been power factor correction. As a result this most obvious benefit quite often obscured the fact that such apparatus will improve voltage conditions. A shunt capacitor connected at some point on a line gives a voltage rise at that point, which is graduated back to the station. This is due to the fact that the capacitor draws over the line with fixed characteristics, a fixed leading current of a magnitude depending upon the capacitor rating. The increased voltage is graduated back to the source since the reactance of the line decreases gradually to that point. Because of this feature or effect of a capacitor, it serves as an excellent supplement to the usual feeder voltage regulator. The boost in voltage caused by the capacitor is fixed and is independent of the load and its power factor, hence the capacitor does not affect the regulation—that is, there is as much variation in voltage at any point on the line after the capacitor installation as before. The feeder regulator reduces the voltage variation between light and peak loads but does not change the difference in voltage between the first and last customer on the line. The capacitor, on the other hand, does reduce the voltage difference between feed points on the circuit and therefore in conjunction with the regulator, produces better regulation. Under the improved conditions with the capacitor in circuit, giving its voltage boost, the regulator need cover only a narrower voltage range—hence a regulator with a smaller range may be used or alternatively, since the duty

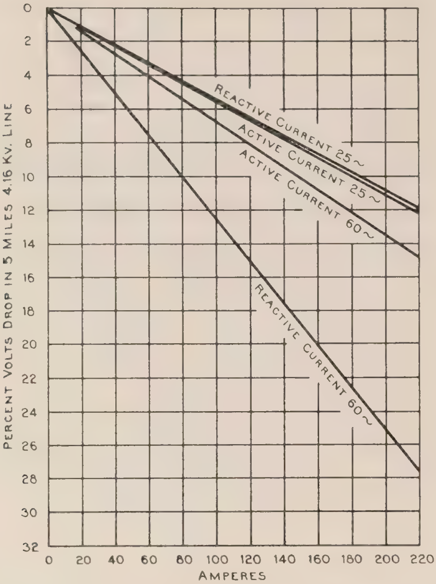


Fig. No. 3—Per cent. voltage drop for two kinds of current.

is lightened, the regulator if of series-parallel construction, is now capable of assuming additional loading and still provide suitable voltage regulation.

The advantages to be gained by the use of shunt capacitors, in connection with voltage improvement are very marked. The proportion of total voltage drop in any feeder, due to the reactive current, is a substantial portion of the total. In Fig. 3 is shown the relative effects on voltage of the active and reactive components of the current in 5 miles of No. 0000, 4160 volt feeder on the basis of both 60 and 25 cycles. It may be noted from this figure that on 60 cycles, 200 amperes active cause a voltage drop along the circuit of 564 volts phase-to-phase, or 13.5 per cent. of the total voltage at the substation end of the line; whereas 200 amperes lagging reactive produce a drop of 1,048 volts, or 25.2 per cent. of the transmitted voltage. It will be evident that since the resistance and reactance characteristics of the line are more nearly equal on the 25 cycle basis, the difference between the effects of the active and reactive components of the current are not so great as on 60 cycle. However, even here, the reactive component is responsible for practically the same voltage drop as the active. Hence, on any 25 or 60 cycle system the reactive amperes are a large factor in causing voltage drop and therefore if this component of the current is reduced or eliminated a substantial gain is made in voltage.

Fig. 4 clearly illustrates the amount of reactive current which exists in

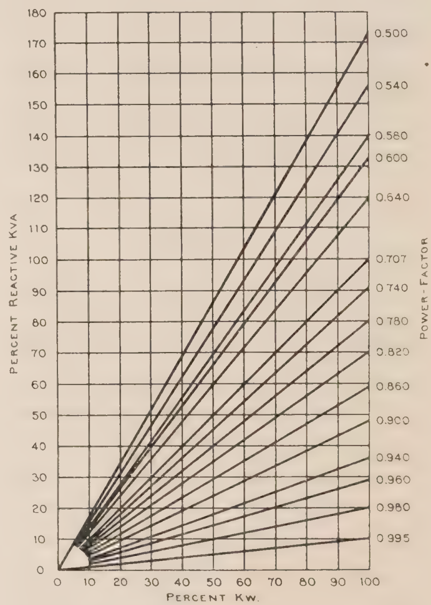


Fig. No. 4—Curves showing graphically the amounts of reactive kv-a. present in a given load at various power factors.

loads at various power factors. At 70.7 per cent. the active and reactive components are equal and in such a case on a 60 cycle basis in the example used above, the reactive component will cause double the drop produced by the in-phase component and on 25 cycles the out-of-phase component will be responsible for as much of the drop as is the power component. Even under the almost perfect conditions of 98 per cent. power factor there still is present 20 per cent. reactive and on 60 cycles this will produce about 40 per cent. as much drop in the ordinary distribution circuit as will the load current. Therefore, on the basis of avoiding excessive voltage drop, correction to unity power factor is warranted. Capacitors afford a readily applied means of accomplishing such desirable results.

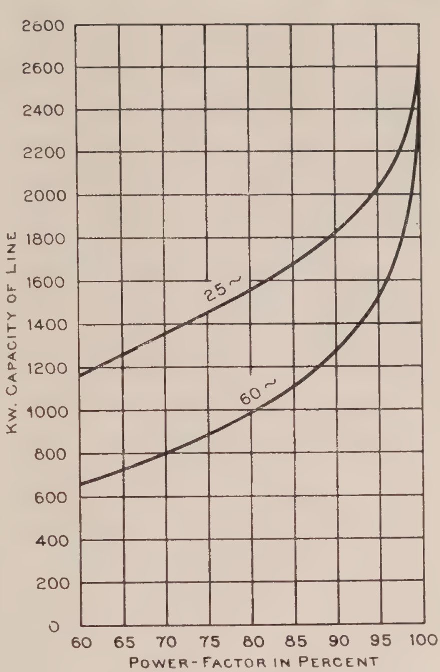


Fig. No. 5—Additional kilowatt line capacity by power factor improvement.

Effect of Power Factor on Kilowatt Loading Capacity of the Line

The power carried by any circuit is limited in practice by the maximum permissible loss and/or the maximum permissible voltage drop. Usually it is found the voltage drop is the limiting factor. In view of this, the improvement of voltage brought about by shunt capacitors will greatly increase the kilowatt carrying ability of the feeders. That this is so, consider the affect on the No. 0000 line referred to above. With voltage drop limited to 4 per cent. per mile, the 60 cycle capacity at 80 per cent. power factor is 980 kw., at 90 per cent. 1,265 kw., and at 100 per cent. 2,660 kw. Likewise on 25 cycles the capacity at 80 per cent. is 1,550 kw., at 90 per cent. 1,820 kw., and at unity, 2,660 kw. Therefore, the kilowatt capacity made available by improving the power factor from 80 to 100 per cent. on 60 cycles is 169 per cent. and on 25 cycles 72 per cent. of the load carrying ability at the lower power factor. In Fig. 5 these facts are clearly indicated and it will be noted that the kilowatt load which can be transmitted without exceeding a fixed voltage drop when the power factor is improved, is very substantial and increases rapidly as unity power factor is approached. This improvement can be accomplished usually without exceeding the current carrying ability of the copper. Fig. 6 shows the amount of capacitor kilovolt-amperes required to produce the kilowatts-carrying-capacity gain shown in Fig. 5.

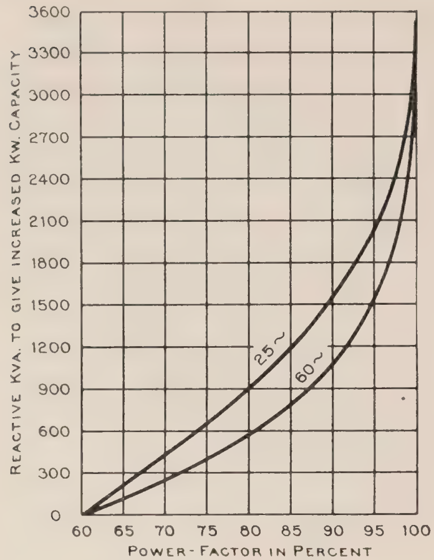


Fig. No. 6—Leading reactive kv-a. required to gain the increase in kilowatt-carrying capacity shown in Fig. 5.

As the power factor approaches unity, there is a rapid increase in the amount of corrective kv-a. required per degree of improvement. For example, to correct a certain load from 99 to 100 per cent. requires 14 kv-a. in corrective equipment, but only 3 kv-a. correction is necessary to improve the same load from 90 to 91 per cent. However, considering the increased kilowatt capacity made available by correction of voltage drop, we find the kilowatt capacity at 100 per cent. over that at 99 per cent. is proportionately greater than that made available by increasing the power factor from 90 to 91 per cent. It can be shown that the kilowatt increase in carrying capacity of a circuit for each kv-a. of capacitor is a constant for a given circuit and original power factor. In other words, for a given circuit and uncorrected power factor, one kv-a. in capacitors will give the same amount of kilowatt improvement regardless of how high the correction is taken. Therefore, as far as economic return is concerned, it is practical to go to unity power factor.

Location of the Shunt Capacitor

The capacitor is an equipment which, because of its ability to draw leading current over a circuit, compensates for lagging current and thus reduces total current. In other words, the capacitor supplies at the point of application the magnetizing current taken by transformers, motors and other pieces of inductive apparatus on the circuit, and thus makes it unnecessary to supply this excitation current from the substation and beyond, and transmit it over the distribution circuits to the point of consumption. Therefore, in studying the economic effect of power factor correction on system operation, it is well to keep in mind that although correction may be applied at any convenient point between the source of low power factor and the generator, yet the recovery of benefits applies only to that portion of the system from the point of application back to the generating source. The obvious location is, therefore, as close to the source of low power factor as is economically and physically possible.

Heretofore, shunt capacitors have been considered by many as of primary importance to industrial users, purchasing power under a power factor penalty rate, but of course, they are not limited to this field. They may be installed at the substation

bus, on the feeders at the load centers, as well as in the power consumers' plants. However, even in the industrial plant, capacitors yield handsome dividends to the utility in better customer relationship and increased utility revenues, due to reduced line losses, improved voltage conditions and more rapid load growth. It is a fact that one of the most important and surest ways to increase the use of electric energy is to lower the cost. There are many examples of this—the Ontario Hydro load growth supports it. The consumer purchase of capacitor equipment lowers his power costs. Encouragement from the power distributors in promoting such action on the part of the industrialist, undoubtedly creates better customer relations, but what is more important, it encourages the wider application of electric energy to other processes such as heating and other loads which were not economical or not considered under former voltage conditions and at the higher power costs.

Results to date indicate that in spite of many such customer-owned installations, the overall system power factor may still be below the economic limit. This may be due to a lower overall power factor in residential areas, where power increases have been comparatively great, owing to the growing use of motorized household devices, or it may be due to the presence on the system of a number of small industrial loads of low power factor or a combination of the two. Frequently, an industrial plant is not of sufficient size to warrant in itself a capacitor application; however, the cumulative effect of a large number of such low power factor loads may overload the distribution facilities and the substation equipment.

Substantial savings can be effected by applying capacitors not only at the substation bus, but also out on the feeders near the loads. The greatest benefits would be obtained by locating the capacitor at the load and distributing it in proportion to the load, but nevertheless, the installation of large blocks of capacity on the distribution substation bus results in savings affecting the substation transformers and, of course, the primary lines back to the generating station. The local utility, however, may not be vitally interested in the effects beyond the incoming high-tension breaker—other than the influence of correction on his terminal voltage. An alternative application, offering further advantages, would be concentration of capacity at the load centers instead of the substation bus. This would show benefits of loss reduction from the load centers back to the substation bus not realized by the installation on the bus.

Many shunt capacitors have been installed in the substations of the Ontario utilities and many more in the industrial plants served by these commissions. These installations are producing excellent results. However, a still more interesting application of a shunt capacitor is one which is located on a distribution feeder remote from the substation. Studies and actual tests have revealed that substantial savings can be effected by applying capacitors out on the feeders near the loads. Such installations may postpone indefinitely investment in new distribution facilities, since they provide the following benefits:

1. A reduced voltage drop in the line with consequent facilitation of voltage control.

2. Increased kilowatt capacity of the feeder resulting from a reduction in current and reduced voltage drop.

3. Reduction in losses resulting from reduction in current.

4. Increased revenue resulting from an increased average voltage in the load area.

It is true the optimum value of all four of these benefits cannot be obtained at the same time. For instance, if the object in view were to correct a poor voltage condition, then it would not be possible to increase the line loading to the ultimate, but a compromise can be established, resulting in the greatest overall economy.

Typical Results of Capacitor Applications

The definite savings in one system, resulting from power factor correction, have already been referred to. In the case cited, the advantages received were due to the installation of correctives by the power company as well as by their customers. Mention has also been made of the general benefits to the utility which result from a consumer installation of a shunt capacitor but the power distributor derives other advantages which may be clearly illustrated in an actual case. A certain utility, by enforcing a power factor clause in its power contracts with the larger customers, raised the system power factor from an average of 67 per cent. to 82 per cent., with resulting benefits. One particular customer installed corrective equipment which saved him several thousands of dollars annually. This amount actually represented the price paid by the utility for its share of the benefits derived from the consumer-purchase of corrective apparatus. An analysis showed that the utility obtained added capacity at a much lower figure than could be secured by increasing the capacity of the feeders and transformers. In addition, the decreased losses in the system and the better voltage regulation and service in general at the higher power factor were appreciable. The point may be raised that the utility could have installed the necessary corrective equipment, and so it could, but an important advantage would have been lost. In order to obtain the same results, it would have had to install the equipment on the customer's premises and be responsible for the operation and maintenance. At the same time, the installation would have lost one of its principal advantages, namely, the incentive to the industrialist to carefully select his equipment and see that it was properly in service at all times. If the customer had nothing to gain or lose he would pay little or no attention to these points and it would cost the utility a great deal more to produce the same results.

Another case in point, involved one particularly bad power factor load on the system of a Western Ontario utility. The utility in question was faced with the necessity of putting in a larger transformer bank or the alternative of inducing the customer to instal corrective equipment. The economy of correction was explained to the customer and a capacitor was

installed which paid the customer well and at the same time the utility found the apparent loss in revenue was an economical solution of the problem, since it deferred investment in a new bank of transformers.

A number of Ontario Hydro utility commissions have installed capacitors on their substation buses with excellent results. One of the earliest was a 90 kilovolt-ampere equipment which was installed in 1928 and due to savings in power costs alone, has paid for itself three or four times over. Incidentally, this particular installation obviated the necessity of a larger transformer bank which would have been required if the power factor had not been improved. Hence, the savings due to this deferred investment also should be credited to the capacitor.

Further evidence of the fact that a shunt capacitor provides benefits to the utility, is the recital of the savings enjoyed by a Central Ontario commission. For a number of years system power factor correction had been taken care of by means of a synchronous motor-driven railway set, but two or three years ago the street railway ceased operations, thus removing the necessity for operating the synchronous machine for other than power factor correction. Upon removal of the street railway load the commission was faced with three alternatives:

1. Operate the synchronous machine for power factor corrective purposes only, or
2. Pay the power factor penalty amounting to about $2,500.00 per year, or
3. Remove the synchronous set and replace it with a 540 kv-a. capacitor.

To operate the synchronous machine at a capacity approximating that required to maintain a power factor of 90 per cent. at the metering point, the losses at an interim power rate of $30.00 per horsepower per year would have amounted to $1,300.00, resulting in a net saving of approximately $1,200.00 annually. Fortunately an opportunity was presented for the sale of the set and a capacitor was installed on the substation bus. The annual losses in the capacitor on the same basis, that is, $30.00 per horsepower per year, amount to $72.00 and therefore, aside from the difference in capital investment, the synchronous motor for equivalent correction would have cost for operation $1,200.00 annually in excess of the capacitor. With the capacitor in operation savings due to penalty elimination alone amount to over $2,400.00 annually, on which basis it paid for itself in a little less than two years.

Since the installation of the capacitor about two years ago, the power factor has never been below 90 per cent. and the fact that the power factor has been kept at this value has meant an improvement in voltage conditions.

As a typical illustration of the benefit of a capacitor installation from the voltage improvement standpoint, mention is made of a case occurring on the Central Ontario System. In this instance the local commission influenced a customer located at the far end of a feeder, to instal a shunt capacitor. As a result the voltage was

boosted 8 volts and satisfactory service was obtained at this customer's plant where before, on account of the large voltage drop, the service had been unsatisfactory.

THE SHUNT CAPACITOR

The capacitor which has already and will continue to produce such beneficial results is not a new device, but it is a modern application of a laboratory product that has been known for over a century and has been in commercial use since 1893. Within recent years it has developed into one of the most dependable and economic devices for power factor correction. The losses are small, not exceeding one-third of one per cent. of the kilovolt-ampere rating, an efficiency not attained by any other electrical apparatus. Capacitors have found wide application in industrial plants for some years and hundreds of installations in Canada are returning substantial savings in power costs.

The fact that the application of shunt capacitors to distribution circuits is fast becoming recognized by distribution engineers as sound engineering and a profitable investment, is largely due to the introduction of pyranol. The use of this non-inflammable, non-explosive dielectric has greatly extended the field of the practical application of shunt capacitors, since the employment of pyranol permitted substantial reductions in the physical size, weight and price of capacitors.

The materials employed in the construction of the capacitor unit consist of carefully manufactured kraft paper and aluminum foil. A rolling

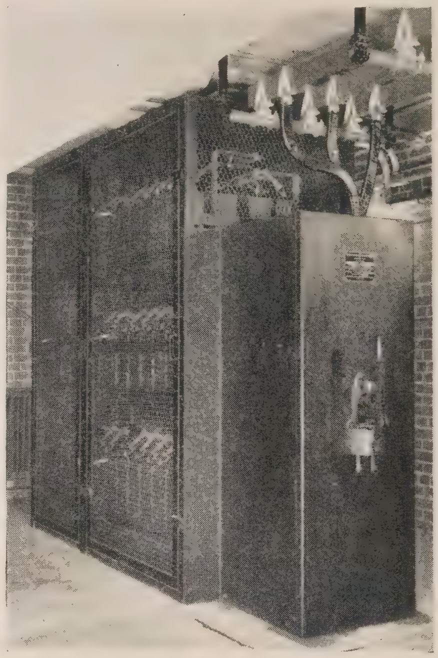


Fig. No. 7—Large rack type indoor capacitor.

process on special machines is used in forming the sections for assembly in the final unit. The sections are collapsed and then grouped for the desired kv-a. capacities. These groups of sections are then put into the metal container or box and are ready for the treating process. Here the dielectric is thoroughly dried out and evacuated of gas by the application of heat and high vacuum, and the impregnation is started. For this purpose carefully prepared pyranol is employed and the process consists of the complete filling of the case under heat and vacuum. With the completion of the filling process, the cases are tightly sealed and subjected to pressure tests for leaks. Electrical tests are then made to determine the exact capacity,

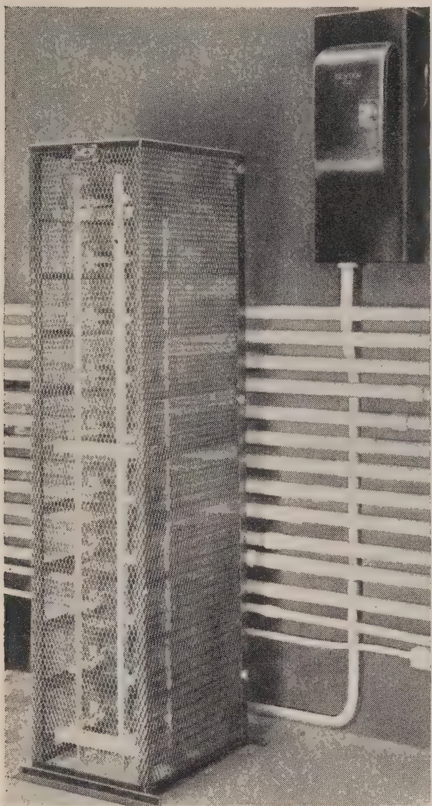


Fig. No. 8—Small rack type indoor capacitor.

the total losses and the usual high potential tests are applied as a check of dielectric and insulation to ground. Following this the units are painted and are then ready for shipment.

The unit so manufactured is the nucleus of any capacitor equipment. Such individual units are mounted on screen enclosed angle iron racks with individual fuses, discharge devices and a main line switch or oil circuit breaker to form standard indoor equipments for the desired voltage and phase connection and of any kv-a. capacity required. The group equipments so constructed are used in industrial plants or in the utility substations. (Figs. 7 and 8). The capacitor is admirably adapted for use in industrial plants where there is usually a minimum of skilled electrical supervision or in unattended substations. The operation of a switch or oil circuit breaker cuts the equipment in or out of service and by removal of individual fuses the corrective kv-a. can be varied to meet any desired condition. Beyond this, the only maintenance required is an occasional inspection of fuses.

In cases where floor space is at a premium, box type equipments for

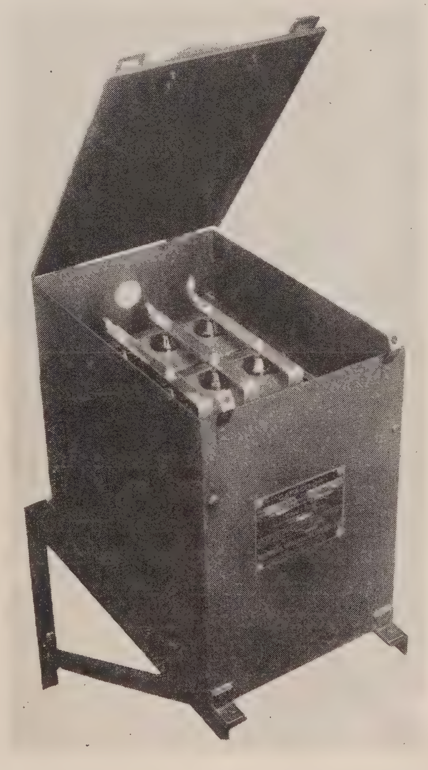


Fig. No. 9—Box type indoor capacitor for wall mounting.

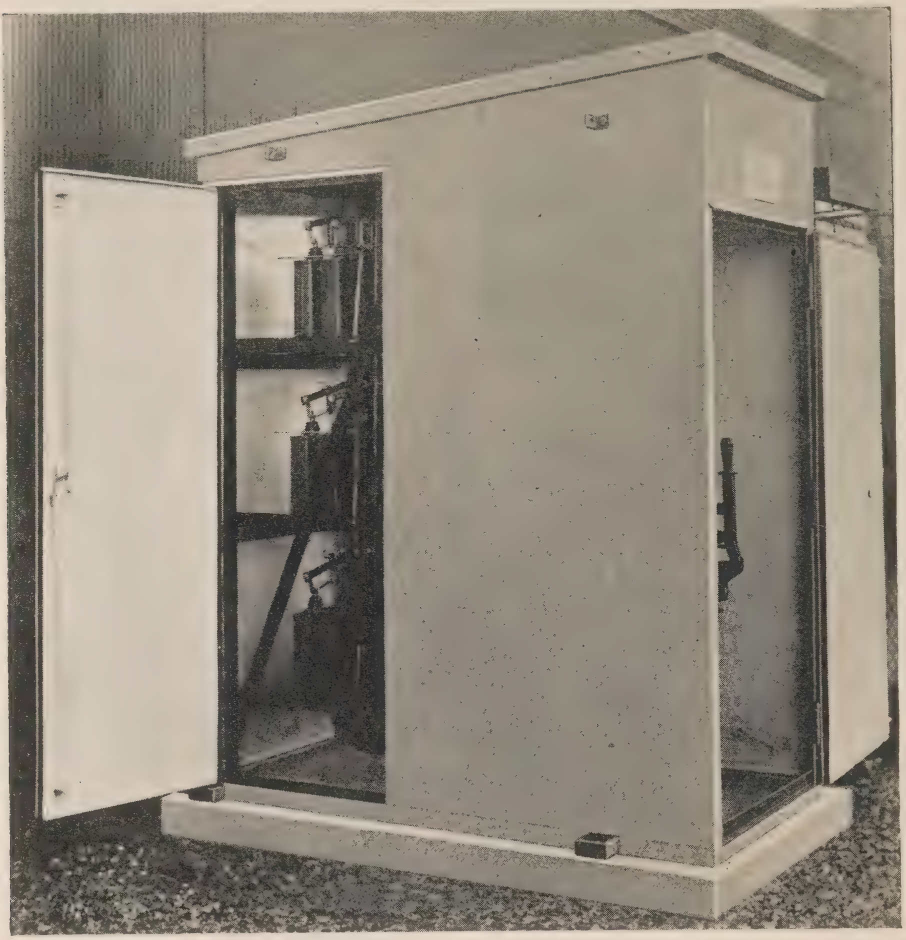


Fig. No. 10—Large group outdoor capacitor.

wall mounting are available in the smaller capacities (Fig. 9).

Where outdoor installations are required, the rack structure is enclosed in a weatherproof metal housing entirely covering the capacitor and circuit breaker. (Fig. 10).

For use on distribution circuits, an outdoor construction designed for pole or platform mounting is available. The units are contained in a metal housing with swinging doors and fusible cut-outs are provided for putting the equipment in or out of service. (Fig. 11). The desired capacity may be installed along the distribution circuit, divided up as necessary to meet requirements of load distribution. The comparatively light weight and small size of the pyranol units has greatly increased the application of these pole type equipments.

An inherent feature of the unit type capacitor construction which is of im-

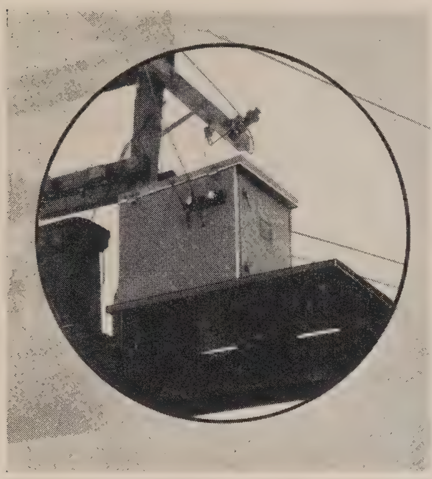


Fig. No. 11—Pole type capacitor for platform mounting.

portance to the utilities, is that it is capable of being split up into various smaller equipments. It is not possible to foresee all possibilities in planning ahead. A big investment in additional distribution equipment may be deferred by the installation of a large capacitor concentrated at one location on the system. Later, changes are made which obviate the necessity of using at that location the total available corrective capacity. In such a case the unit type equipment may be broken up and the released sections may be used advantageously elsewhere on the system.

CONCLUSION

Power factor correction will be found to be an economical and readily applied means of obtaining increased capacity quickly, and both industrialists and the utilities would do well to study the opportunities thus presented. In addition, there are problems of voltage control which are interlinked with the subject of power factor. On account of the large investment involved, the distribution system must be utilized efficiently and a comparatively large investment in capacitors is not only justified but necessitated by the increasing demands for power. In many cases the judicious application of capacitors will improve voltage conditions which otherwise would be such as to practically nullify the use of available electric energy because of improper voltage.

Capacitors are undoubtedly the answer to many pressing problems of distribution. With a minimum investment they provide increased capacity of feeders, regulators and transformers. They reduce energy losses in distribution circuits, and they improve voltage. They possess advantages, common to static equipment, such as low operating cost, low maintenance expense, low installation cost and years of service have proved their reliability. They simplify power distribution and create substantial savings for the utilities and their customers. Their use represents the kind of progress that results in more efficient and hence greater use of electric power.

ANNOUNCING

THE OPENING OF THE

1937 ELECTRIC RANGE CAMPAIGN

AS in the past two years, the Hydro municipalities have urged the Commission to promote and sponsor an Electric Range Campaign.

The Commission has been encouraged by the results of the previous campaigns to carry on against this year with renewed vigor and is providing the necessary stimulants to municipalities, manufacturers, dealers and Hydro consumers to insure a successful campaign again for 1937.

The 1937 Electric Range Campaign
—opened April 15th—

To help all branches of the industry the Hydro-Electric Power Commission is contributing handsomely by

- Providing advertising material—such as mats and cuts—for newspaper advertising by municipalities and dealers.
- Providing window display material for Hydro Shops and Dealers.
- Providing a special advertising allowance to dealers on all new Electric Ranges sold by them.
- Providing educational matter on electric cookery for newspaper work.
- Displaying Electric Ranges in Rural Offices.
- Carrying on an extensive campaign in all Rural Power Districts.
- Organizing an ELECTRIC RANGE WEEK in as many municipalities as will co-operate.
- Doing everything else possible to help the Electrical industry and Hydro municipalities promote the use of Hydro.

We solicit the co-operation of all Hydro municipalities to help one another in this new drive.

HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO

DISPLAY OF NEWSPAPER ADVERTISEMENTS

Mats or stereos provided Free—Ads are 1, 2, 3 and 4 column to meet all requirements.

DISPLAY OF WINDOW CARDS AND BANNERS

Complete sets or individual cards supplied to municipalities and dealers Free on request.

An Opportunity for Executives

By Wills Maclachlan, Secretary-Treasurer and Engineer,
Electrical Employers Association of Ontario

(Presented to joint meeting of Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Toronto, February 3rd, 1937.)

ON January 1st, 1915, there came into effect in Ontario, the Workmen's Compensation Act that had been passed at the previous session of the Legislature. This Act removed from the courts, actions to recover from employers, compensation for employees' injuries that were the result of accidents to employees while at work and placed the matter under the jurisdiction of a Workmen's Compensation Board. "No action shall lie for the recovery of the compensation, whether it is payable by the employer individually or out of the accident fund, but all claims for compensation shall be heard and determined by the Board." The amount and character of this compensation is very clearly defined and the Act, further, states that the compensation shall be provided or paid for by the employer. "Wherein any employment to which this part applies, personal injury by accident arising out of and in the course of the employment, is caused to a workman, his employer shall be liable to provide or to pay compensation in the manner and to the extent hereinafter provided . . . " The Act, further, specifically covers Public Utilities Commissions. "The exercise and performance of the powers and duties of . . . a Public Utilities Commission . . . shall for the purposes of Part 1, be deemed the trade or business of the . . . Commission, but the obligation to pay compensation under Part 1, shall apply only to such part of the trade or business as, if it were carried on by a Company or an individual, would be an industry for the time being included in Schedule 1 or Schedule 2, and to workmen employed in or in connection therewith". Since in Ontario, there are companies and individuals operating public utilities included in Schedule 1 and in Schedule 2 there is no doubt that the electrical public utility commissions are included in Part 1, of the Act.

Two methods of paying the costs of accidents are made possible to employers under the Act: "Employers in the industries for the time being included in *Schedule* 1, shall be liable to contribute to the accident fund as hereinafter provided, but shall not be liable individually to pay compensation." "Employers in the industries for the time being included in *Schedule* 2, shall be liable individually to pay the compensation." The public utilities commissions and municipally-owned electrical systems were originally placed in Schedule 2. Many of these utilities found that the financial risk of the cost of accidents was too great to be borne individually and

formally requested the Workmen's Compensation Board to place them in Schedule 1. Under Schedule 1, employers carrying out like work, are placed in the same class or sub-class. The assessment rate charged these employers depends definitely upon the cost of the accidents to their employees. In other words, the class or sub-class is very similar to a mutual insurance company.

Briefly stated, the Workmen's Compensation Act removes the liability of an employer being sued because of an accident to an employee while at work, but provides that the employers either individually or collectively shall pay the costs of these employee accidents. If an employee is injured while at work, the compensation, medical and hospital costs must be paid.

The logical method to meet this situation should surely be to prevent the accident in the first place. This is the only method open to lower costs under the Workmen's Compensation Act and this holds whether the employer is liable under Schedule 1, or Schedule 2. Accident Prevention will also, without doubt, increase the efficiency of the organization. Aside entirely from the financial or economic aspect of the situation, it is the humane thing to prevent accidents. The untold suffering of the injured man and his family is surely an unnecessary by-product of service to the community.

Provision is made in the Act for organized Accident Prevention. "The employers in any of the Classes for the time being in Schedule 1, may form themselves into an Association for Accident Prevention . . ." Such an organization for the public utilities which are covered in Class 22, is the Electrical Employers Association of Ontario. It is the oldest of the associations under the Act, being formed in 1914 and coming into active operation January 1st, 1915, at the same time as the Act.

For those employers in Schedule 1, the Workmen's Compensation Board reviews the accidents, pays the costs of the accidents and sets a rate that will supply sufficient money to cover the costs. For those employers in Schedule 2, the Board reviews the accidents, pays the costs of the accidents and bills the employer for the cost. In each case the Board simply deals with the accidents according to the provisions of the Act and sees to it that the employers provide sufficient money to pay the cost. The Board cannot lower the costs but the employer and employee may, by preventing accidents.

Why should a commissioner, manager or superintendent be interested in the prevention of accidents? Surely since the employees are the ones liable to be injured, they will be careful and prevent accidents. Unfortunately, it does not work out that way. The executives of any organization direct the policy of that organization. To the executive alone is given the opportunity of establishing a policy of the safe, as well as efficient rendering of service. Without this policy being laid down, little progress can be made. The executive is responsible for the financial standing of the organization. Accidents cost money. There is no doubt that every expenditure of an organi-

zation is carefully scrutinized. Should not the cost of accidents receive the same scrutiny? If an accident occurs, the costs are inevitable. On a cold-blooded financial basis, is it not better to make expenditures to prevent the accident than to pay the costs of the accident?

In those organizations which have, by effort either eliminated or greatly reduced accidents, the executives are probably the first to express real and warranted pride in the accomplishment. One has only to discuss the prevention of accidents with a manager of a plant that has gone some years without an accident, to realize the pride that he has in the result of a work well done. There is much more satisfaction from this pride than in extending sympathy to an injured employee or to his family.

When men are out doing their regular work in sleet or rain, there is no doubt that the executive wishes to be able to say to himself that "he has made their work as safe as lies in his power." If he can say this, he will sleep better at night. This is no figure of imagination as any operating executive knows.

What, specifically, can a commissioner, manager or superintendent do to prevent accidents? Give a definite leadership to the work. Some may say that this is his definite responsibility. There is no doubt, however, that to him and to him alone is given the opportunity of leadership. He, like the Centurian, says: "Unto one, go, and he goeth and to another come, and he cometh." Men look to the boss for leadership.

There should be a specific Minute, or Executive Order, of the local Public Utilities Commission, or Board of Management, stating that the work shall be carried out safely and efficiently. Where necessary this minute, or order, should be amplified to cover specific safe methods and practices.

In the selection and placement of the staff, much effective work can be done. Character and ordinary gumption are too frequently lost sight of in choosing men. A medical examination for selection and placement is also well warranted. A man who is colour blind is a hazard to himself, and others, as a switchboard operator. Five per cent. of males are colour blind. A man with bad knees or back will play out if put in a lineman's job. Care should certainly be taken in selecting the right man for the particular job. The mental qualifications of a groundman are different from those required for a lineman or meterman. The technical training of staff requires more and more attention. Systems and apparatus are becoming much more complicated. Many large systems are establishing schools for linemen and foremen. The time may not be far distant when such a school or series of schools would not be out of place in Ontario. Such a school can, with profit, teach why a job is done in a certain way, as well as how it is done.

The human element of a public utility is the crux of the situation. In a number of meetings held during the past year, the following sentence was generally agreed to: "Experienced men and competent supervisors who

jointly recognize the hazard and take the necessary precautions will not have accidents."

Plant and Tools

The plant and tools of the utility should be carefully surveyed and reported upon to the executive. The butts of poles should be systematically inspected and a thorough survey made. A pole may look perfectly safe above the ground line and be rotten below the ground line.

In the more recently built power houses and substations, the practice of clearly placing the name on each switch has been followed. This naming is done so that in the emergency the wrong switch will not be operated. This practice, although first carried out only on high tension switches, has been extended to include low tension switches and even lighting switches. This practice is definitely to be recommended and if it had been universally in effect, would have prevented serious accidents.

Linemen, generally, are using standard linemen's belts, the practice being for the utility to purchase, own and maintain the belts. In some instances, however, this practice is not in effect. If the belt fails and the man is injured, the employer either individually or with others, pays the cost. Would it not be better to buy a good belt and maintain it in the first place? Where the practice of the utility owning the belt has been put into effect, no man has been injured due to the failure of a belt. The policy outlined for the belts, equally applies to spurs and other tools and equipment.

A word about hand tools might not be out of place. Mushroomed-headed chisels have been responsible for the loss of many eyes. These chisels should be properly dressed. The use of a sponge rubber fitted over the chisel will frequently prevent severe injury to the hand if the hammer slips. Rope should be purchased according to rigid specifications and then well maintained. Goggles for protecting the eyes from flying chips of steel or cement, are available and should be supplied. There are also goggles available for protecting the eyes from electrical flash while switching or changing fuses.

Methods of Work

Recently there have been in Ontario a number of severe injuries to employees as a result of falling with a pole. This usually occurs when a lineman is cutting wires at the top of the pole. If the pole is weak or rotten at or near the ground line, there is a great likelihood of it breaking. If the lineman is strapped to the pole by his belt and the pole falls, the resulting injury is frequently severe and at times fatal. A definite practice of testing the butts of all poles before climbing should be put into effect. If the strain of the wires is to be changed, the pole should be temporarily guyed by hand lines or suitable ropes before climbing to do the work. It should be noted that the strain may be changed even by cutting or untying primaries, secondaries, service wires or guys.

Without doubt, the most severe hazard met with in an electrical public utility is the hazard of electrical

burns or shock. Experience has shown that the greatest hazard is that of the lineman coming in contact with live primary lines, having a voltage of 2,200 or 4,000. Work on or near these primary lines is for the purpose of maintaining continuous service. If the lines could be killed, the work would be comparatively safe but service to consumers would suffer. At times, it is frankly Bill Jones risking his life so that Mrs. John Smith will have electrical service to do her washing. Surely there is some method of maintaining a reasonable service with safety to the men. If the system is broken into smaller parts by the use of sectionalizing switches, it will be possible to de-energize a small section, causing a temporary inconvenience to a few customers and make it possible to work on a dead line. At times, this does not seem possible and work must be carried out on or near live primaries. For live work, at least two thoroughly experienced linemen should be present, fully equipped with rubber gloves, rubber line hose and other necessary equipment and be under the immediate supervision of a competent line foreman. The linemen should put their gloves on at the base of the pole and wear them until they return to the base. Four feet below the lowest crossarm they should stop climbing, look over the work, and then proceed with their job.

In view of the fact that electrical shock is one of the major hazards, intensive study has been made of the information available as to the effect on the human body, of the passage of electrical current and the best remedial measures to put into effect. This study has covered available literature, laboratory research, collection of statistics of cases in the field and practical field experience. As a result of this study, it is found that the best results are obtained from the prompt and continuous application of the Standard Technique or Prone Pressure Method of Artificial Respiration carried out by trained men. Since prompt application is necessary, all men in the utility must be trained; there is no time to send for help. Excitement is also frequently present after an accident. To offset this, it has been found that regular practice will greatly assist in getting prompt application of artificial respiration, in spite of the excitement.

The larger organizations require at least one practice of artificial respiration by each man per month; many require one per week. Records are kept of these practices, including a roll of those participating.

Since March, 1936, public utility men and their families have, in Ontario, resuscitated five persons from electrical shock, two from drowning and two from gas poisoning. This is no mean accomplishment.

It has been found that many severe accidents are the result of misuse of simple equipment and tools. A severe fracture of the hip of a lineman was due to not correctly snapping the snap into the D ring of his belt. Men should be taught how to use belts, spurs, gloves, hammers, chisels, solder pots, etc. There are many correct and safe ways to use these tools and equipment and the man should be taught and be required to carry out

these safe and, incidentally, efficient methods.

RESULTS FROM ACCIDENT PREVENTION

It is extremely difficult to present exact information proving the monetary value of the Prevention of Accidents. It is easy to say that the accident just "did not happen." These arguments equally apply, however, in regard to ordinary advertising, but it would be a foolish board of directors who would dispense with advertising. An analysis of the twenty year period—January 1, 1915, to December 31, 1934, however, shows some trends. During this period active Accident Prevention work has been carried out by the Electrical Employers Association. Many of the executives and employees of the utilities have fully co-operated. The benefits to the injured workmen under the Workmen's Compensation Act have been greatly increased during this period and hence the cost of the individual accident of a like type has been increased. Comparing the costs to the utilities in Class 22 (The Utility Class) it is shown that if the costs obtained during the period 1915-1919 were applied to the period 1930-1934, some $90,000.00 more in assessments would have been required from the utilities. The fatal accidents for a like payroll in the period 1930-1934 were 65 per cent. less than in the period 1915-1919. These are two definite comparisons of which there can be no question and show clearly that accident prevention pays and prevents fatal accidents.

To sum up, if an accident occurs, the employer pays the cost and the employee and his family suffer. To the executive is given a great opportunity to give leadership in a worthwhile job. By organization, accidents can be prevented. Will you not avail yourself of this opportunity and do what lies in your power?

A.M.E.U. Committee Reports

Merchandising Committee

A meeting of the Merchandising Committee was called to discuss merchandising and campaign problems of various Hydro municipalities and the discussion centered around the 3 principal activities of Hydro municipalities now in progress, namely, the Water Heater Campaign, the Range Campaign and the Lighting Campaign.

RE WATER HEATER CAMPAIGN

One of the first questions asked was whether the Water Heater Campaign was being prosecuted with the same results as attended the efforts of the municipalities at the beginning of the campaign, and in this connection the installation results of this year were made known to the committee, these being to the effect that since October

31st last year about 8,000 flat rate heaters have been installed and nearly 5,000 booster heaters, and that the results up to date are approximately 36,000 flat rate and 12,000 booster heaters. It would thus appear that the rate of installation is being steadily maintained.

The problems of various municipalities in connection with the installation and servicing of water heaters were discussed and it was recommended that since the Toronto Hydro has had the widest experience in both the installation and servicing of heaters it would be desirable to have a representative of the Toronto Commission prepare material for discussion at the A.M.E.U. Convention early in 1937 based on "Problems Involved in the Installation and Servicing of Hydro Water Heaters." This discussion should include not only the manner in which heaters are installed and serviced, but typical examples of unusual installations brought to the attention of the delegates, particular reference being given to commercial installations involving large capacity in tanks and heaters.

RE HYDRO RANGE CAMPAIGN

The Secretary presented a report showing the results of the Range Campaign for the first year and for 1936 up to date, giving the comparisons of ranges installed in each inspection area of the Province, and these results indicate that the Hydro-Electric Range Campaign has stimulated range sales to a very marked degree, and that the results of 1936 show an improvement over those of 1935. It was pointed out also that in the municipalities where real effort was put into the campaign by the local commission in co-operation with the dealers that very satisfactory results were obtained. Particular attention was drawn to Fort William and Port Arthur, Lindsay, Oshawa, Whitby, Strathroy and a few others where a Hydro Shop is not being conducted, yet where the local commission got right behind the campaign and made a real job of it. Then, of course, the results of the various energetic Hydro Shops again show the advantages of having a merchandising department when campaigns such as a Range Campaign are to be put on.

The figures which we have for new electric ranges sold during a full year —from April 1st, 1935, to April 1st, 1936—were approximately 6,500, and from April 1st to October 31st, the installations were about 4,500. It is not possible to give exact figures because of the delays occasioned in the inspection of ranges in outlying districts. The rate of installation is increasing since August, showing up the results of advertising and sales effort by all branches of the industry during the early months of the campaign.

It was pointed out that one of the outstanding features responsible for the installation of electric ranges has been the assistance given by various municipalities to the installation of 3-wire services and range connections. Another good feature of the campaign has been the $3.00 allowance offered to dealers by the Hydro-Electric Power Commission, and the members of the committee expressed their approval of the advertising and organizing efforts

which the Commission has put at the disposal of the municipalities and requested that the Commission continue to serve the municipalities and the electric range manufacturers and dealers through advertising assistance and the advertising allowance as they have during the past two years.

Considerable discussion took place on the sale price of electric ranges, the opinion being advanced that if the cost of electric ranges were brought more in line with gas ranges, model for model, considerable impetus would be given to the sale of electric ranges. The feeling is that a casual inspection of electric and gas ranges of the same type and manufacture fails to disclose the difference in price at which these two commodities are sold to the public, and it is difficult for a salesman to convince a prospect that the difference in the list price represents extra value and extra service.

In discussing the results of the campaign, and pointing to municipalities where results were not as good as might be expected, the opinion was expressed that perhaps some educational propaganda should be spread among various Hydro Commissions to lay before them the advantages of more complete co-operation in the promotion of range sales for load building purposes as well as for the purpose of giving better service to their customers.

The Secretary reported to the meeting the progress which has been made in the testing of range elements, and stated that practically all makes of replacement range elements have been tested at the Commission's Laboratory as well as a large number of standard range elements, and that the results of these tests are being tabulated and will be available for Hydro municipalities in the very near future. The purpose of this test is to enable municipalities to judge for themselves the value of replacement elements as compared to standard elements and to formulate some policy involving the use of either type of elements in the rehabilitation of electric ranges which are in need of repair and replacement of elements at the present time.

Re Lighting Campaign

The progress which has been made in promoting Better Light for Better Seeing was outlined to the Committee, and the various problems in connection therewith discussed. The committee was informed that lighting campaigns were actually in progress in about 35 municipalities of the Province and indications are that more are to be added to the list as soon as organization can be completed and persons found who could carry on the work of promoting Better Light for Better Sight.

The results of the operation of lighting campaigns in various municipalities were discussed and the opinion was expressed that the lighting campaigns such as the Commission is trying to organize are well worth while, especially if the local commission puts its energies into the activity. The outstanding example of what can be accomplished if this is done is the town of Simcoe. A year ago the Simcoe Commission employed a Home Lighting Advisor, one who was trained by the Hydro-Electric Power

Commission, and put her to work. She organized the municipality along the lines recommended, securing the co-operation of the manufacturers, dealers and others in the municipality, and the net result of her year's efforts in the way of sales alone by the dealers is as follows:

400 I.E.S. Floor and Table Lamps.
500 other Portable Lamps.
300 New Shades.
30 Semi-Indirect Fixtures.
50 Ordinary Fixtures.
25 Make-Overs.
110 Shades, Sprayed.

Simcoe is a town of 5,500 population, or approximately, 1,100 families, and these figures show that an average of one lamp was sold per family and only half the town was covered in the campaign. Most of the lamps sold required bulbs of much larger capacity than customers were in the habit of using, so that there must have been a very substantial increase in the installed capacity and in the consumption of these added lamps.

* * * *

Committee on Accounting and Office Administration

A convention session of this committee was held at the Royal York Hotel on Thursday, January 30, 1936, with D. B. McColl of Walkerville, in the chair. There were some fifty-eight municipal Hydro representatives in attendance. This committee convened at breakfast time and after breakfast, routine business was transacted.

A paper was presented by J. F. Cook of the Windsor Hydro-Electric System on "Collections". This paper was well received and considerable discussion as to collection methods, etc., arose therefrom.

The sub-committee under the chairmanship of M. W. Rogers of Carleton Place, investigating methods of handling Consumers' Deposits reported progress.

The principle of placing Consumers' Deposits under control was adopted.

Feeling reference was made to the passing of R. E. Garrett, of Sarnia, who was a valued member of the committee for some time.

A meeting of the committee was also held at the Chateau Laurier, Ottawa, on July 3, 1936, at 8 a.m. George Appleton of the Toronto Hydro-Electric System was in the chair and there were some thirty representatives in attendance.

After breakfast the meeting convened for the purpose of transacting routine business and then the following special features were discussed:

1. *Stub Plan Billing*

This subject was introduced by W. G. Henderson, of Cobourg, and considerable discussion resulted.

2. *The Inactive Ledger*

This subject was introduced by I. N. Pritchard, of Chatham, and considerable discussion took place. The consensus of opinion was that the Inactive Ledger was very necessary and should be installed in all Municipalities as soon as possible.

The detail in respect to "The Inactive Ledger" has been printed in a subsequent issue of the Bulletin.

The Committee records with great regret the passing of W. H. Childs, of Hamilton, who was this year appointed by the Executive Committee as

Chairman of the Committee. The late Mr. Childs was very much interested in accounting and office administration affairs and has given valuable co-operation for some time past.

* * * *

Committee on Accident Prevention and Health Promotion

During the year the Committee has held two meetings and has discussed various matters dealing with Accident Prevention that have come before it.

The Toronto Hydro-Electric System has prepared an excellent rule book, Rules and Instructions for Safety of Employees, during the past year and it has been decided to have reprints made of this rule book and that it be issued at the price of 35c each to the municipalities. It is hoped that each municipality will purchase sufficient rule books to supply one copy to each employee.

There has been brought up from time to time, a recommendation that means be made possible for the discussion of operating and construction methods among the superintendents of various municipal systems. It is recommended that a suitable subject dealing with this subject be chosen and that a meeting of superintendents of municipalities in a selected area be held as an experiment, with the thought, that this might be expanded to a number of areas in a province-wide scheme.

As a result of discussion at the committee meetings, a paper has been prepared and will be presented at the forthcoming convention of the Association dealing with the question of the Prevention of Accidents.

* * * *

Regulations and Standards Committee

The Regulations and Standards Committee held a meeting on December 11, 1936, in Room 3C, H.E.P.C. Building, University Avenue, Toronto.

The meeting was called to consider a letter from J. Eckersley of the Toronto Hydro-Electric System with reference to the proposed changes in the regulations for the testing of watthour meters before sealing.

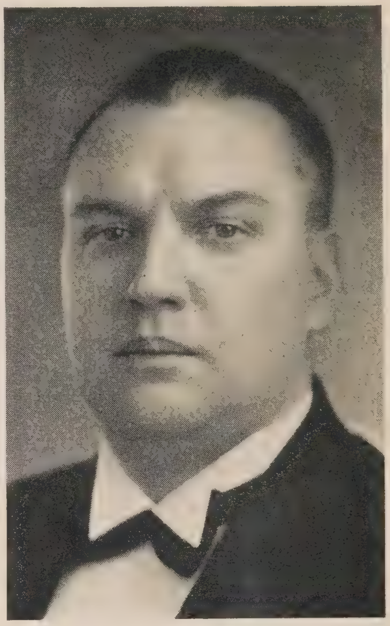
This matter was before this committee the previous year. The chairman was asked to write to J. L. Stiver, Director of Electricity and Gas Inspection Services, Ottawa, and find what are the intentions of the Department in this connection.

As a result we obtained from Mr. Stiver, under date of December 29, 1936, a copy of the latest draft of the proposed regulations, but he stated "this was for the information of the committee. These regulations had not been finally decided on, and the opinion of the committee would be appreciated." However, he further stated that the proposed draft was for the information of the committee only, and not for publication.

As these proposed regulations were received too late to come before our committee, one of the first duties of the new committee will be to give them consideration.

W. T. Kingston, Cardinal

Walter T. Kingston, Secretary-Treasurer of Cardinal Hydro-Electric System, passed away suddenly on Friday, March 12th, 1937. He was taken to his bed about ten days before with an acute form of arthritis. After a few days he seemed to be returning to normal health and had made sufficient recovery to permit his performing some of his business duties in his home. While so engaged on Friday afternoon he complained of weariness and soon afterwards was seized with a severe heart attack from which he died.


Walter T. Kingston

Mr. Kingston was born at Prescott, Ontario in 1886, where he attended public and high schools and served his apprenticeship as a druggist. In 1909 he graduated from the Ontario College of Pharmacy and received the degree of Phm. B. from the University of Toronto. A drug business had just become available in Cardinal of which Mr. Kingston took charge for himself and continued to operate until the time of his death.

As a citizen of Cardinal, Mr. Kingston was keenly interested in all activities, business, municipal, social, religious, and fraternal, and was looked upon as the one from whom the life of the village emanated. In municipal affairs he was Clerk and Treasurer of the village, and when Cardinal contracted for power from the Hydro-Electric Power Commission of Ontario in 1930, he became Secretary-Treasurer of the Cardinal Hydro-Electric System.

By his fraternal associations, Mr. Kingston was known throughout eastern Ontario and also in the larger centres of the whole province. To him the teachings of those societies and his church were a standard which he endeavoured to practice. One who knew him best has described him as a true Christian gentleman.

Mr. Kingston is survived by two sisters and three brothers and also fifteen nieces and nephews, and to these we extend our sympathy. His wife predeceased him some eight years ago.

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Hydro Water Heaters for Commercial Consumers

By J. F. Thomlinson, Power Engineer, Toronto Hydro-Electric System

(Presented to Association of Municipal Electrical Utilities at Toronto, February 3, 1937.)

THE purpose of this brief paper is to outline our experience and present practice in dealing with the problem of Hydro Water Heaters for commercial consumers. I shall try to be as concise as possible, in the hope that there will be time afterwards for discussion, and that as many of you as are interested will enter into the discussion.

At the outset, I should say that in Toronto we have not considered the installation of Hydro Heaters for any applications except those where the water heated is used as hot water in the common everyday way.

If there are any differences between the requirements of a commercial installation and a residential one, they would appear to be these: relatively greater storage capacity, and quicker recovery.

The first commercial jobs tackled were those smaller ones, where, say, up to 90 or 100 gallons of hot water per day are required. Such jobs were handled by the installation of a single tank of the required size up to a No. 100 tank equipped with immersion heaters in either the bottom opening or in both upper and lower openings when necessary.

We later adopted circulation type heaters for all jobs, whether commercial or domestic, from one kilowatt up. We have found that we get quicker recovery with the circulation type of heater which delivers hot water directly at the top of the tank. This avoids the mixing and cooling of the hot water as it rises through the cooler water above it, that occurs when immersion heaters at the bottom of the tank are used.

In the earlier days of the plan, we made our own circulation heaters using a $1\frac{1}{2}$-inch pipe as the casing into which the Standard Immersion Unit, supplied under the Hydro Plan was fitted. We now, however, purchase castings made to our own specifications for use as heater casings. When circulation heaters are used, all the outside fittings, including heater casings and connecting piping are insulated.

Where the quantity of water required was greater than could be provided by a No. 100 tank, with the maximum capacity of heaters that could satisfactorily be installed in this tank, we were forced to adopt some other method. Our first thought was to put two tanks in series, and a few such installations have been made. The two tanks are not necessarily of the same size, nor do they necessarily have the same heater capacity installed.

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The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

The earliest installations used immersion heaters, but as mentioned before, no immersion heaters are now used on jobs of one kilowatt and over. There are certain obvious objections to a Series System, and we then tried out a Multiple System of tanks with a common header.

At this point it might be as well to outline some of the considerations that have led us to limit the size of tank used to the No. 100, and where more storage capacity is required, to instal additional tanks. Such a policy has both advantages and disadvantages. Among the advantages are the following:—

(1) This is the largest tank that in many instances can be easily gotten into the premises.

(2) Larger tanks would require special mountings, which in some instances would have to be incorporated into the building structure. This might lead to complications should it be necessary, later, to remove the equipment.

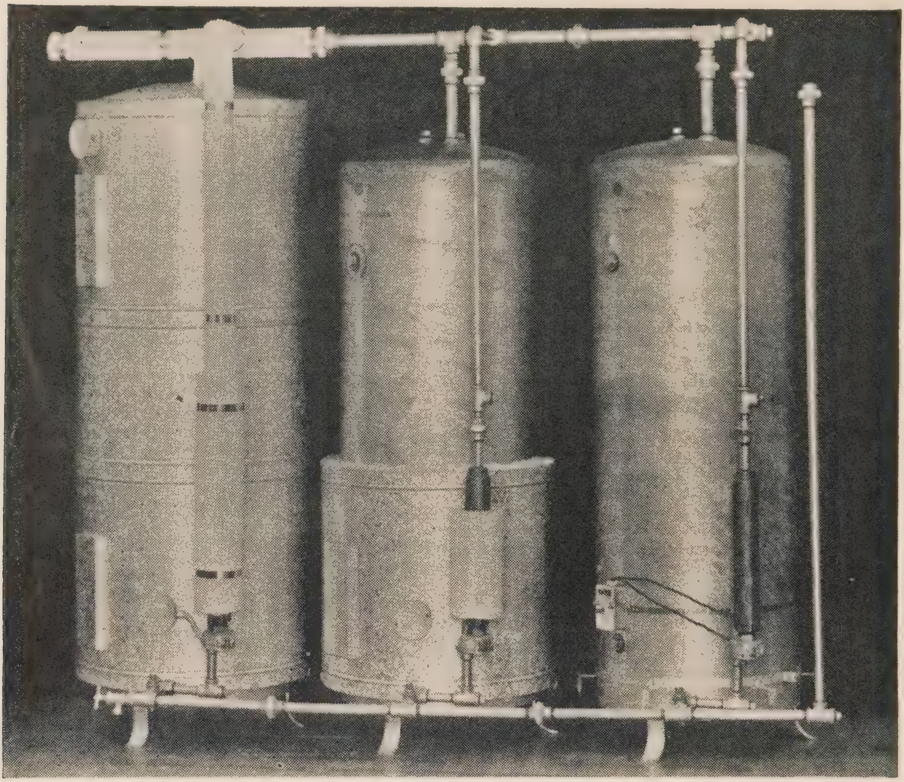
(3) Should the contract expire, no use might be found for a large tank for some time, as it would be only suitable for a limited number of jobs.

(4) Within certain limits, the use of a number of small tanks is a more flexible installation, permitting of easy adjustments should load conditions change sufficiently to require them. For example, another tank can often be added to take care of increased hot water requirements, not foreseen at the outset. In this connection it might be said that it is often extremely difficult to forecast accurately a new consumer's hot water requirements.

(5) Such a plan enables us to use all standard equipment, with the exception of the heater castings, exactly as supplied by the H.E.P.C. to all municipalities that have adopted the plan.

(6) In case of a tank failure, it is comparatively easy to replace in a reasonable time, any tank up to a No. 100, whereas, with a larger tank it would be quite a problem.

(7) From a tank cost stand-point, I believe it is actually cheaper to use a number of smaller tanks up to No. 100, which are produced in quantity,



Arrangement of tanks, pipes, etc., of a three-tank assembly.

than it would be to buy special, larger tanks, which might have to be built to order.

Among the disadvantages are the following:—

(1) Naturally, a number of small tanks will not be as efficient from a heat storage stand-point, because of the increased radiation losses.

(2) The installation requires more room, and this is often quite a problem.

These are a few of the main points that were considered, and led to our decision to use no tanks larger than No. 100.

We have found the multiple arrangement of tanks, with a one-inch header eminently satisfactory. The largest job we have so far been called on to instal has five tanks in multiple. Each tank is equipped with two 2 kw. circulation heaters, making a total of 20 kw.

Diagramatically, the arrangement of tanks, pipes, etc., as used by the Toronto System is as shown. If any-one is particularly interested in this hook-up we have three tanks set up at 14 Carlton Street, and your inspection is invited.

How does one decide what arrangement of tanks, and what heating capacity to recommend? On a

changeover from some other system of heating, wherever possible we install a hot water meter and actually measure the hot water requirements up to as long a period as one week if time permits. Many changeovers, however, are emergency propositions, and no time for measuring hot water requirements can be allowed. In such cases, as also for entirely new jobs, we obtain as much information as possible from the consumer as to his water requirements, size up the job paying particular attention to tank location, to eliminate as much as possible long runs of pipe, especially horizontal, or pipe runs in exposed locations, etc. Then a reasonable usage of water from most of the usual types of hot water outlets, can be estimated in most cases—and for the rest, experience from other jobs is the best guide.

Commercial consumers, even as residential, often waste water to an unbelievable extent. One outstanding example will serve to illustrate this point. A restaurant chain that uses a number of Hydro Heaters was preparing to open a new addition to the chain. As they proposed to change the type of restaurant, broadening out their menu, too much dependence could not be placed on their previous experience as a basis of estimating their hot water requirements. After carefully studying the matter, and conferring with their representatives, it was decided to start off with five tanks in multiple, and a total heater capacity of 12½ kilowatts. At their request, this was gradually increased at intervals, until 20 kilowatts was ultimately the total. Fortunately, in the original wiring installation we had allowed sufficient margin for this capacity. Still later, even with 20 kilowatts, they started running out of hot water about the middle of the afternoon once or twice a week. Anticipating the winter period and lower incoming water temperatures, they requested an additional 5 kw. We knew that this involved a major wiring job, and before doing anything, made a further check-up. Water meter readings indicated a maximum consumption of 1700 gallons of hot water on one particular day. This enormous figure was closely approached on several occasions during a two-week test period. To provide such a quantity of hot water, if it became a regular requirement, would of course need more like 35 kilowatts. We established the fact that there was no relation between the number of persons served and the hot water used, also that compared with other restaurants of a similar type, the hot water consumption was unreasonably high. We had previously suggested, as we invariably do, that it would be a good thing to have spring taps installed on all hot water outlets, but this had not been done. We had one more interview with the consumer, and before we left his office, heard him issue instructions that all hot water outlets in this particular restaurant be immediately equipped with spring taps. The average daily consumption taken from two weeks readings of the water meter, is now under 900 gal-

lons a day and, of course, the 20 kilowatts installed is ample for this consumption.

In conclusion, I wish to acknowledge valuable assistance received in the preparation of this paper from my associates in the Toronto Hydro-Electric System, Messrs. W. S. Bushell of the Water Heater Section, Appliances Department, and H. M. Guscott, of the Appliances Department.

Promoting Our Business

By M. E. Skinner, Vice-President, Buffalo, Niagara and Eastern Power Corporation, Buffalo, N.Y.

(Address to Ontario Municipal Electric Association and Association of Municipal Electrical Utilities at Toronto, February 3, 1937.)

BEFORE we start "Promoting Our Business" I suppose it would be pertinent to ask ourselves, "*Why* Promote Our Business?". There are some who have held the view that electricity supply systems should be content to make good service available at low rates and to allow the patrons to determine solely for themselves the extent to which they care to use the service. Under such a premise there would be no reason for any form of business promotion. However, among enlightened public utility circles there is today an increasing acceptance of the theory that "Public Service is a Public Trust" and that the electric supply should be administered in the public interest. This is true whether it is owned and operated by the government or whether it is privately owned and operating under public regulation.

Approaching our question with this concept we can answer it affirmatively if we determine that an increased use of service is in the public interest. To me this is a self-evident truth but we might review briefly the reasoning back of it. We, who know what electricity can do, fully appreciate its superiority for almost every application of light, heat or power. Nowhere is this superiority more striking than in the home. Electricity has relegated all other forms of lighting to oblivion. Who would go back to the dirty, smelly, dangerous, kerosene lamp or, for that matter, to the oxygen consuming, annoyingly frail, and still dangerous, Welsbach gas mantle. Or who would trade the easy convenience of the electric-washer or vacuum cleaner for the drudgery of washboard and broom? There can be no argument on such comparisons. And the same superiority of the electric way extends through every household application down to such trivial uses as curling milady's hair. That being so, isn't it

Brundage farm—General view.

self-evident that the maximum use of electricity will extend its blessings to the public in most generous measure?

Public satisfaction with our service seems to grow almost in proportion to the extent to which our patrons use it. It is our experience, and I believe it is yours, that the people who use electricity most liberally are the most satisfied customers. It is the customer who niggardly uses only a few kilowatt-hours who is most likely to be a chronic kicker on the quality or cost of the service. I believe that a generous use of electricity definitely improves the attitude of the public toward the management of the utility service.

If we now consider that people will only use a service when they know about it and fully understand the advantages to them of such use, I believe we will all be ready to agree that we should promote our business. Our obligation to do so is made more clear if we recognize that with respect to many of the things which electricity can do, no one else has sufficient incentive to engage in the educational work necessary to accomplish a public appreciation of its superiority. The manufacturer and retailer of electrical devices has a selfish interest in the development of a market for his goods but, in many cases, the amount of his profit incentive will not permit much market development. And besides, he wants to keep his profit.

Then there are other applications where a competing service is constantly trying to discredit electricity to further its own ends. Probably the best illustration is the electric cook stove. Suppliers of gas, coal, oil or wood as well as the suppliers of cooking equipment to use these fuels are constantly at work belittling the advantages of electricity and emphasizing the advantage they often enjoy of lower cost equipment or lower operating expense.

I hope this discussion has been sufficient to convince you that we *should* promote our business. We still might argue the extent to which we should engage in such promotion. However, that is a matter which is so involved with local conditions that it cannot be accorded any general conclusion and had best be left to the judgment of those who thoroughly understand the local problem. Suffice it to say, that the cost of promoting business, even when on a comparatively elaborate scale, is still only a small percentage of the annual revenues involved.

Now that we are ready to promote our business how shall we do it? This

Brundage farm—Good lighting in the dairy stable

question involves consideration of the fields of activity open to us and the methods which we may employ. Basically, promotion consists of education and the same fundamental methods apply irrespective of the application being considered.

The fundamental methods available to us may be classified as:

1. Advertising.
2. Demonstration.
3. Sales Power.

Advertising may be carried on through any of the media that you are familiar with such as:

1. Newspapers.
2. Envelope enclosures or imprints.
3. Pamphlets and literature.
4. Direct mail.
5. Radio broadcasting.
6. Lectures.
7. Displays—in the office, in show windows, on billboards or in connection with public exhibits.

Each of these media has its special advantages and its limitations and the choice between methods or combinations will rest on a knowledge of what they can do and the type of market under development. Two things only would I like to mention in regard to advertising. Remember first, the old Chinese saying, "One picture is worth 10,000 words." And second, remember that your appeal will be most forceful if it interprets the advantages to the prospect. Too many times we see advertising built around gadgets which appeal to the advertiser as interesting. If we are appealing to the home market we should remember that the ultimate decision on our appeal will probably be made by a woman.

The second broad classification of methods which I mentioned was demonstration. It is much more convincing than the advertising appeal but also more costly. It can be carried on with individuals or before groups large or small. Generally speaking, the effectiveness as well as the cost per person are increased as the demonstration is personalized down to the individual as the limit. For this reason, the proper use of demonstrations requires finely balanced judgment and a careful weighing of the cost as compared with the

Brundage farm—Battery brooder.

results. Demonstration is tremendously effective, however, and its use should be considered wherever possible for this reason.

Sometimes demonstrations take the form of elaborately staged affairs before large bodies of people. Showmanship is very important in such cases and, as a matter of fact, is important in all demonstration work. Anything that is worth while doing is more worth while if done well and showmanship is an important way of increasing the effectiveness of any demonstration. A little later I will show some slides illustrating some of the more elaborate forms of demonstration that have been used by the companies which I represent.

Sales Power is the third and probably the most important means of promotion at our disposal. Most important because without it the advertising and demonstration may be largely wasted and because without them it will still be effective to a certain degree. There is no doubt but that the efficiency of any selling organization is enhanced by proper advertising and demonstration support, but sales can be made without them. Sales Power is the clincher that makes the idea stick.

By sales power I do not mean to restrict myself to those men and women employed directly by the utility. There is a great deal of other sales power in any community that has an interest in common with the utility. Most of it, however, is being individually applied and its effectiveness can be increased many times if it is furnished enlightened and effective leadership. Thus the dealers and

Brundage farm—Electric milk cooler, aerator and circulating pump.

merchants who sell electrical goods are interested with the utility in a wide distribution of such goods. Their interest is the profit they can derive while the utility interest is in increasing the use of electricity. These two interests may not have the same balance in different applications. For example, the profit interest would greatly outweigh the kilowatt-hour interest in electric clocks while the reverse would be true of a water heater. Regardless of variations in this balance of interest a careful appraisal of each application will always indicate an equitable basis for cooperative action.

Now let us consider for a few minutes the fields of activity which are open to us. To conserve time I will not attempt to go into the many commercial and industrial applications of electricity. To treat them adequately would require a great deal more time than is at my disposal. Further, we find that for such applications the prospective user has ready access to sources of information. The manufacturer of equipment has enough at

stake to justify direct contact with such prospects and the prospects' competition forces him to be alert to every opportunity for improvement in his establishment. These reasons are sufficient to justify us in confining our analysis to two other fields of wide application and interest—Lighting and Appliances.

In passing up a discussion of these working kilowatts connected to our lines we must not forget their importance. In addition to improving system load factor and so reducing the cost of all kilowatt-hours, it is the activity of these working kilowatts that provides the payrolls and purchasing power so vital to business prosperity. In our eagerness to please the great mass of residential users we must not overlook these important working kilowatts.

The lighting field in itself is almost unlimited in scope and is particularly important to us because it forms the backlog of our present business and one of the greatest opportunities for future service. The principal divisions of this field of lighting are:

1. Homes.
2. Offices.
3. Factories.
4. Streets and highways.
5. Stores.
6. Schools and Public Buildings.

At the present time lighting in all these fields is enjoying a tremendous boom in the United States largely as a result of the Better Light, Better Sight movement. I know that you have a treat in store at noon and I would not attempt to trespass on Dr. Luckiesh on his subject. His laboratory is the source of most of the scientific data on which this new concept of light rests and he has a most delightful and dynamic way of interpreting these data for the layman. However, having served since its inception as Chairman of the National Better Light, Better Sight Bureau, I find it difficult indeed not to mention some of the promotional aspects of this activity.

In the first place, it is a perfect illustration of the potency of interpreting our service in terms of benefit to the user and some of the other principles which I have discussed.

ANNUAL SUMMARY
ENERGY CONSUMPTION AND WORK RECORD
R. W. BRUNDAGE DEMONSTRATION FARM, OAKFIELD, N.Y.
NOVEMBER 1, 1935 TO NOVEMBER 1, 1936

TOTAL ANNUAL CONSUMPTION AND COST

Electricity Used During Year		Cost to Customer	Average Monthly Consumption	Average Monthly Cost	Average Daily Cost	Average Cost Per Kw-hr.
Residence	7,160 kw-hr.	$124.48	597	$10.37	$0.34	1.74c.
Poultry Farm	7,622 kw-hr.	132.51	635	11.04	0.362	1.74c.
Dairy Farm	5,972 kw-hr.	103.82	497	8.65	0.284	1.74c.
Portable Motor	177 kw-hr.	3.08	15	.26	0.008	1.74c.
Total	20,931 kw-hr.	$363.89	1,744	$30.32	$0.994	1.74c.

Modern electric home—Entrance.

For years light was accepted with little consideration given to quantity or quality. Then Dr. Luckiesh developed his concept of the triangle of seeing and the interrelation of light, object and eyes on our ability to see. Carrying this a step farther, he began to make us understand that seeing and seeing well were intimately related to human welfare. It remained only for us to coin the slogan which epitomized this concept—Better Light, Better Sight—and to marshall all parties at interest to develop the common objective. The result is a national movement of irresistible power which in three short years has brought the lighting industry from the very depths of depression to an all-time peak of activity. Some twenty trade groups have associated themselves in this endeavor each one interpreting the common objective in terms of their own interest and carrying it to the highways and by-ways by every known vehicle of promotion. This activity is not confined to the United States but is blanketing Canada as well and now has its counterpart in many foreign countries.

I ask the simple question "What is being done in your community to capitalize on this activity?" We in the United States find that local benefits flow almost in proportion to local activity and in this the local utility must be looked to for leadership. I know that a great deal has already been done in Canada but I believe that the organization of a suitable agency to direct and co-ordinate your work along this line might pay handsome dividends.

I mentioned street and highway lighting as one of the important fields for development. I do not know what the figures are for Canada but last year there were about 38,500 traffic fatalities in the United States. Of these approximately 60 per cent. were during the hours of darkness when an average of only two cars out of seven were on the road. Can anyone doubt that inability to see danger in time to avoid it was not a principal cause for this tragic toll of life and limb? We are just about ready to admit that the vehicle itself cannot provide proper illumination. Stronger headlights only aggravate the difficulty at the critical moment when cars are passing. The correct solution is the proper lighting of the highway itself. Demonstrations are being undertaken in many places and I confidently believe we will see the day soon when our main traffic arteries are properly lighted so that it will be almost as safe to drive at night as it is in the daytime. Could we devote ourselves

to any worthier cause than Better Light for Better Safety?

And now just a few comments on the appliance field. In the home the principal appliances in order of electricity consumption include:

1. Water Heater.
2. Range.
3. Refrigerator.

In each instance the service these appliances render in the home can be furnished by some other type of equipment using a source of energy other than electricity. In each case if purchasers select the electric item they must do so because they have become convinced of the superiority of the electric method over its competitor. If they have had no opportunity to experience these superior qualities they must be told about them or they must witness a convincing demonstration. The necessity for this education is greatest for the water heater, somewhat less for the range and least in case of the refrigerator. In the case of heated water there isn't much difference whether it is heated with electricity or with something else. You want it

Modern electric home—Living room.

Modern electric home—Dining room.

hot, uniform in temperature, and always ready at the turn of the faucet. To be sure there are definite advantages in favor of electricity but why should the man on the street take trouble to search them out? In the case of electric cookery the superior results are easier to detect and, in the case of the refrigerator, they are almost universally admitted.

I cite these illustrations to show the difference in the state of mind of the public toward different electric appliances and to indicate the wide variation in promotional treatment which they require. If we now consider the substantial selling effort put back of refrigerators by profit-minded dealers and compare it with their almost complete lack of interest in water heaters, the problem before the utility becomes quite clear.

I want to hasten to add that I am familiar with the Hydro water heater program and to congratulate you upon its tremendous success. We think so well of it that we have copied many of its features and adapted them to our own sales program. Your water heater plan illustrates many of

Modern electric home—Kitchen.

the principles I have discussed this morning.

It seems appropriate to refer at this point to a promotional activity that is making great headway in the United States, namely, Kitchen Planning. For years the efforts to relieve kitchen drudgery have been centered on the improvement of individual appliances. Recently home economists, search facilities of our educational institutions have developed the possibilities of improving kitchen efficiency by proper placement of the kitchen equipment. We now have new concepts and a host of new terms such as work centers, toe room, etc. With it has come a renewed interest in an old friend—the all-electric kitchen. Incidentally, our competitors have waked up and are sponsoring the all-gas kitchen. Women have been quick to respond to these suggestions for improved working conditions and are avidly seeking information on the subject. It is characteristic that once they see a plan of how their kitchen might actually look when equipped with modern appliances and properly planned they are not content until it is an accomplished reality. Even though handicapped by lack of money and obliged to make the change a step at a time they cling tenaciously to their objective.

This new movement has proved to be a very effective means of developing interest in electric service in the kitchen and is being used as a promotional vehicle by many utility companies in the United States. It is another illustration of a national movement being given wide publicity that has real possibilities for local tie-in which can effectively promote our business.

All the appliances which find use in an urban home have a place in the farm home and, in addition, there are numerous applications for the use of electricity which are peculiar to farms. Probably the first desire of a farm family securing high line service for the first time is for a supply of running water. Then, in addition to all the household uses, we find such applications as milking machines and coolers for dairy farms, soil heating for truck farms, incubators and brooders for the poultry

Modern electric home—Bedroom.

farm. The problem of making the farmer familiar with these applications and with the advantages they offer him is complicated by several factors. First, the distance involved in reaching the farmer from the centers of population makes it expensive for the dealer to contact him as compared with the urban customer. Second, the cash income from farming is low, so that the farmer is a cautious buyer and is frequently embarrassed by lack of ready cash. Third, farm habits are hard to change which makes selling more difficult.

These factors conspire to lessen the interest of profit-minded dealers in the farm market and place an increased responsibility upon the electrical supply system serving farm territory to furnish the farmer information and guidance. I realize that many of you manage utilities who confine their activities to densely populated communities. I mention the problem in the hope that you will be sympathetic to those who are confronted with the responsibility for serving rural areas.

In conclusion, I have a few slides which show three of the most interesting promotional activities which we have been conducting recently. The first is a completely electrified demonstration farm which the Niagara, Lockport and Ontario Power Company has maintained near Batavia for several years. In this project, it enjoys the full co-operation of the owner and operator of the farm, Ralph W. Brundage. The company installed the added wiring and appliances necessary to complete the electrification, with the understanding that special prices would apply to the added equipment if Mr. Brundage decided to keep them. In return, he agrees to allow inspection groups to visit the farm and maintains an elaborate cost record system to demonstrate the economy of operation. This is a practical working farm—not in any sense a model or sport farm. The owner makes his living exclusively from farming operations.

The second promotion is the model home which the Buffalo General Electric Company constructed on the main floor of its office building in Buffalo. In co-operation with some 100 manufacturers, wholesalers, and retailers this exhibit was constructed to demonstrate the use of electricity in the home, particularly for lighting. Since its opening in November, 1934, some 80,000 people have been conducted through the home by trained hostesses who give a complete explanation of all its features including a 15-minute lecture on Better Light, Better Sight, and its practical application in the home. At the conclusion of their trip they are given a souvenir booklet for their future reference.

The third type of promotion is what we called our Best Cook Contest. In successive communities we sponsored this contest in co-operation with a local newspaper. The object was to find the best cook in each district as demonstrated by her ability to bake apple pie. At the conclusion, the whole town was invited to a mammoth celebration in the local armory or theater at which

time the prize winners were announced and all were given a spectacular demonstration of electric cookery. When almost 2,000 people pack the armory in a town of 6,000 people you can be sure that the townpeople became acutely aware of electric cookery.

A Method of Adjusting Rotating Machines to Correct Dynamic Mechanical Balance

By H. S. Baker, Meter Supervisor, H.E.P.C. of Ont.

A ROTOR is in static balance when it will stand in any position on frictionless bearings with the shaft horizontal, but it may cause serious vibration when brought up to speed.

This vibration is caused by one side of the rotor being too heavy at one end, while the opposite side is too heavy at the other end. In this case the rotor is in perfect static balance, but is out of dynamic balance.

Various means are used to take readings of errors in dynamic balance, but the following is submitted as simple and effective and not requiring the rotor to be removed from the machine.

The method consists, in brief, of reading electrically, the fundamental frequency component of the vibration at one end of the stator (with the rotor up to speed) and correcting the same to zero by application of a weight to that end of the rotor. Then repeat on the other end and repeat again on the first end. The fundamental frequency referred to means one cycle per revolution of the rotor.

Fig. 1 shows the hook-up, wherein the voltage delivered by a radio loud speaker, subjected to the vibrations to be measured, is connected in series with the voltage from a bipolar a.c. magneto generator connected to the rotor shaft.

The vector sum of these two voltages shows on an a.c. voltmeter, preferably rectifier type, and the time phase of the voltage from the magneto is varied till the vector sum is a maximum. At this point, the voltmeter reading and the phase position of the magneto voltage is recorded.

Then the phase position is again varied until a minimum voltmeter reading is obtained and recorded.

The magneto generator stator is carried on a frame embracing the two outside bearing bosses with a friction pressure, thus the stator can be swung around while the rotor is in motion.

A dial on the stator, co-axial with the rotor shaft is marked in degrees of angle and a pointer on the above frame shows the angle at which the stator is standing. This angle gives the time phase position of the a.c. voltage delivered by the magneto. Any

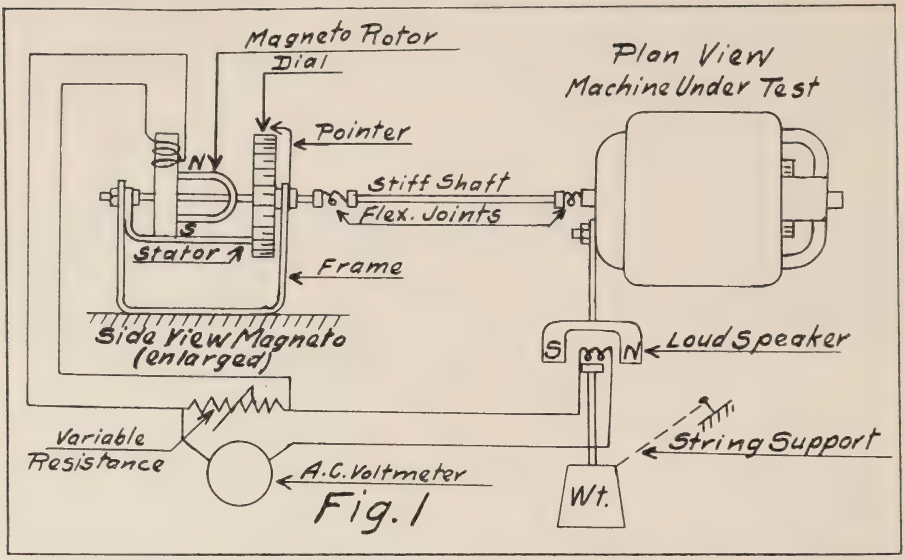


Fig. 1

position of this dial in relation to the stator gives the same results for the purpose in hand.

The output of this generator, in the present model, is 1 volt at 1000 rev. per min. roughly, but this is reduced by the shunting variable resistance shown until the output voltage is somewhat greater than the voltage of the loud speaker under severe vibration conditions.

The full scale voltage of the voltmeter used depends on the severity of the vibrations to be measured. A one or two volt full scale is likely to be suitable, but a very low range (high resistance meter) such as a rectifier type can have its range increased to desired values by insertion of resistance.

A five-ampere dry rectifier applied to a d.c. voltmeter is not suitable to use as an a.c. voltmeter. The dry rectifier must be very small in order to give it sufficient current density to properly rectify. The rectifiers supplied in a.c. rectifying voltmeters are made small enough for the purpose.

The permanent magnet element of the loud speaker is clamped to the end of the machine under test and the moving coil or moving iron element of the speaker is clamped to a weight of a few pounds which is supported by a string. The loud speaker assembly is mounted horizontally to read the horizontal vibration at right angles to the shaft.

The procedure of test readings is as follows:—

With no corrective weights applied to the rotor, an "as found" reading is taken by connecting up as shown and, with the machine at full speed, slowly turn the stator of the magneto around until the voltmeter shows maximum reading. To get an accurate reading of the phase angle at maximum voltmeter reading, the phase should be swung ahead and behind until a definite reading below maximum is reached. Midway be-

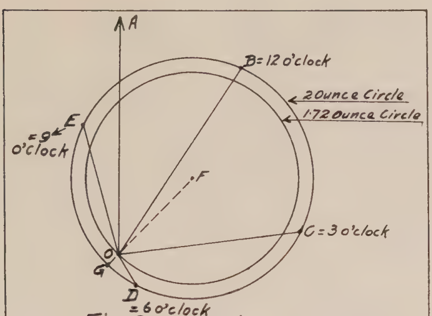


Fig. 2 - Vibration Diagram

tween is the maximum phase position. Note this reading and also the phase position of the magneto. Now turn the stator to get a minimum reading and note it.

The difference between the maximum and minimum readings is plotted in Fig. 2 as O F. Here the length O F is made to represent to some scale the above difference and the angle A O F is the phase angle reading. This line O F represents the "as found" fundamental frequency component of the vibration at that end of the machine.

Now place some arbitrary angle marks on the end of the rotor of the machine under test. Call these marks 1.00 o'clock, 2.00 o'clock, etc. Place an arbitrary weight, say two ounces, at the 12.00 o'clock position.

Repeat the vibration reading and get the line O B (Fig. 2).

Move the two ounce weight to the 3.00 o'clock position and get the line O C (Fig. 2).

Similarly the 6.00 and 9.00 o'clock readings are O D and O E.

The circle through B C D E may be called the two ounce circle and its centre will be the point F as already located.

Draw the line F O G and find that the distance F O is 1.72 ounces to the same scale that F G is two ounces. Note also that the "o'clock position" of F O is about 6.45.

Make a weight of 1.72 ounces and attach it to the rotor in the "o'clock position" of 6.45.

If all readings have been accurate, then a repeat reading with the 1.72 ounce weight in place should show zero fundamental frequency vibration.

Now move the speaker to the opposite end of the machine and adjust it to zero. Then return to the first end and a small further adjustment may be necessary.

The magneto generator is preferably made with a wide air gap and fairly tapered pole tips in order to approximate to a sine-wave voltage output wave.

If a very bad wave form is used and if the harmonics in the vibration under test are very bad, then more than one maximum will be obtained on the voltmeter as the phase position of the magneto is varied.

The vector addition of the voltage from the magneto to the voltage from the speaker, greatly reduces the effect of harmonics in the vibration under test from showing on the voltmeter. This is because any two different frequency voltages connected in series add in quadrature. These "off frequency" vibrations may be caused by other machines in the same building or may be caused by the double frequency magnetic pull of the a.c. source feeding the machine under test. Considerable time is saved by providing means for dynamic or mechanical breaking to adjust weights.

Then and Now

THROUGHOUT the centuries, since history began to record human thought, we find that men, worried by the cares and perplexities of an increasingly complex civilization, have looked back longingly to times when life was simpler and have spoken wistfully of a by-gone, golden age.

Some of us may wonder whether the hurry and worry of modern life are worth while—may be disposed to contrast it unfavourably with the simpler living of what we may think of as the good old days of our forefathers. It may help us to appraise our present state more justly if we examine the actual standards of living when this country of ours was young. I quote from Bogart's Economic History of the United States.

After the Revolution, "the unskilled workmen earned on the average about two shillings a day; the hours of labour were from sunrise to sunset. . . . Little beyond the bare necessities of life were secured by the labourer for his wage. The home of a working man about 1790 is described as follows: 'Sand sprinkled on the floor did duty as a carpet. There was no china in his cupboard; there were no prints on his wall. What a stove was, he did not know; coal he had never seen; matches he had never heard of . . . He rarely tasted fresh meat as often as once a week and paid for it a price much higher than his posterity . . . A pair of buckskin or leathern breeches, a red flannel jacket, a checked shirt, a rusty felt hat cocked up at the corners, shoes of neat's skin set off by large buckles of brass, and a leathern apron, comprised his scanty wardrobe. The leather he smeared with grease to keep it soft and flexible'."

A workman to-day would regard such living conditions as intolerable. Then, even the wealthiest lacked such things as are considered necessaries in the average home to-day—such things as hot and cold running water, bath tubs, central heating, electric lights, and the telephone, to say nothing of the various conveniences and comforts such as radio, electric refrigeration, vacuum cleaners, electric irons, and all the other appliances that make home life easier and more enjoyable.

All these things have come from scientific research or from the application of scientific knowledge to production methods. Research has revealed the possibility of new things like electric light, the telephone, and radio. Engineering, which is applied science, has made possible the production of all these things at a cost within the range of the average pocketbook.

Also, in the early days of this country, the average man had no contact with anyone but his immediate neighbours. To-day the newspaper, with its telegraphic and cable services, keeps him promptly informed of events the world over, while the radio brings the whole world to his home.

If my great grandfather broke his hip, there was no X-ray to insure its

proper setting. If he cut his foot, there was no modern antiseptic he could use to guard against infection. If gangrene set in, his life might be saved by prompt amputation, but he must endure the agony of the operation with no anaesthetic. Moreover, because neither the surgeon's instruments nor his bandages had been sterilized, infection would be quite likely to set in again. The average life of man has been lengthened by more than a score of years in the past century.

If my great grandfather travelled by sea, he was dependent on fickle winds. No meteorological reports by radio would warn him from the path of approaching storms; no radio beacon would give him his bearings; no radio aboard would summon aid in case of accident. At home and abroad, he had to face countless dangers against which science guards us to-day.

Science watches over the purity of the water and milk we drink and of the food we eat; it lights our homes, workshops, offices and streets, heightening our comfort, convenience, efficiency, and safety; it has relieved men and women of much drudgery in the factory, in the field, and in the home; it furnishes our quick and comfortable transportation, whether downtown by trolley car, bus, or automobile, or across the country by train or plane. In sickness or accident, science assures us competent care in hygienic surroundings with relatives, friends, and business associates wherever they may be; it brings to our homes for our entertainment, information, and instruction the best of music, the most important news, and the ablest speakers that the whole world can furnish.

Every appliance or machine which reduces our labour and heightens our efficiency does more than to add to our comfort and conveniences. It does more than to relieve man's muscles and to serve his physical needs. By increasing his hours of leisure, it serves also his cultural needs. It confers greater opportunity for the pursuit of intellectual and aesthetic interests as well as for the wholesome relaxation of play. Through its gifts, science has indeed marvellously raised the material standards of living, but it has also given us the chance, if we accept it, of elevating the far more important mental standards of life.

When we compare life to-day with conditions when our country was young, we find the standards of living incomparably higher, the hardships and dangers incomparably less, and life itself incomparably fuller, richer, and safer. If our forefathers could find, in the midst of hardship, danger, and deprivation, much to be thankful for, surely we should not fail to appreciate our much greater blessings, nor should we fail in our grateful appreciation of the accomplishments of science to which we owe these blessings.

—*From a recent G-E Science Forum talk by Dr. W. D. Coolidge in "General Electric Review".*

Rehabilitating Flood Damaged Ranges in London

THE unprecedented floods that inundated the districts along the valleys of the Thames, Avon and Grand rivers in southwestern Ontario during the last week in April left damage in loss of life and in millions of dollars of property. In London and vicinity, the Thames river flood water worked havoc to the waterworks, street lighting, railway and electric light and power systems as well as to many homes.

In addition to making a special effort to return services under its control the Public Utilities Commission of London also extended its activities towards putting consumers' equipment back into condition for use as soon as they would become prepared to use it. The accompanying illustration is of a few of the ranges reconditioned after the flood.

When these ranges were first brought in it was necessary to use a hose on them in order to remove the mud. They were then moved to the Repair Shop where burners and oven insulation were removed. Heat was applied to dry out the wiring so that it would not be grounded when the power was turned on.

Some of the electric ranges reconditioned for consumers by the Public Utilities Commission of London.

After the drying process was completed, new insulation was placed in the ovens, burners were replaced, switches cleaned and oiled, and the ranges completely cleaned ready to send back to the customers.

Up to the second week in May, 225 ranges have been reconditioned and 59 have been returned to the customers. This work was completed by 15 men, of these 5 are of the regular staff, which number also includes delivery men. The approximate cost of rehabilitating these ranges would be: 5 hours time, 40 lbs. insulation per range, average cost $4.75 each (actual cost). This does not take care of delivering the ranges back to the customers.

Studying the Heavens

By F. K. Dalton, H.E.P.C. Laboratories

FEW things in this world will draw a crowd more surely and more readily than an astronomical telescope set up in a location where the public can reach it, —evidence of the inborn human curiosity regarding the Universe, and of the desire to see and to learn more about the celestial bodies. The subject of astronomy, therefore, proves an excellent study for an inquiring mind at any age and, with the continuous drama of events which take place, it will retain its interest.

The earliest observers of the heavens saw only sun, moon and stars. These they watched and worshipped, imagining that the sun and moon were rulers of the day and night and that certain creatures and forms were depicted in the stars. There were many superstitions relating to these heavenly bodies, and the origin of the grouping of the stars into constellations, as also the naming of them, are hidden in ancient mythology.

The more systematic observers noticed that five of the brighter stars changed their positions in relation to the other stars, and called them, "the planets". These always appeared in a certain belt in the sky which was divided conventionally into twelve equal parts, constellations of equal width, and named "the zodiac", or zone of animals, the majority of these constellations being thought to depict living things. The "Signs of the Zodiac", as the twelve groups of stars came to be known, are as follows:—

Aries, the Ram.
Taurus, the Bull.
Gemini, the Twins.
Cancer, the Crab.
Leo, the Lion.
Virgo, the Virgin.
Libra, the Scales.
Scorpio, the Scorpion.
Sagittarius, the Archer.
Capricornus, the Sea-goat.
Aquarius, the Water Carrier.
Pisces, the Fishes.

The sun, and the moon, as well as the five known planets, moved through the zodiac. Upon this fact, the ancient art of Astrology was founded, the system of forecasting the future of mankind by considering the influence exerted by the sun, moon and planets in their various positions in the different signs of the zodiac, the combination of positions being noted for the date of birth of each individual and also being observed on the starting of some new enterprise. Each of these celestial bodies brought certain predictions according to the particular sign of the zodiac in which it appeared at the critical time. The number of possible combinations of positions of these seven bodies appears to be 3,732,480.

With the knowledge which had already been gained, observers watched still more carefully and determined with remarkable accuracy the periods of the planets,—i.e. the lengths of their years,—and also the lunar month. They even discovered that the whole series of eclipses of the sun and moon is repeated at regular intervals of 18 years, 11⅓ days,—a period known as the "Saros". In fact, practically all of the information about the sky which can be obtained without the use of optical instruments was known to the ancients as a result of their accurate and systematic observations.

Various theories regarding the heavens were then advanced, the earth being considered the centre of the Universe in all cases until Copernicus explained the solar system as having the sun at the centre with all of the planets, the earth included, revolving around it in various periods of time, and Kepler found that they travel in elliptical orbits.

Even with this explained, however, there still remained this mystery as to what keeps the planets in their places and what force makes them move. It was thought that they were placed at the ends of invisible spokes, as of a wheel with the sun as hub, or that angels guided them around in their courses, but Sir Isaac Newton, in his study of the law of gravity, found that the natural attraction between the celestial bodies was all that was necessary to hold the planets in their orbits, and the moon in its path, and that, being once started, as they already had been, there was no force tending to stop them. The mystery then remaining was the manner in which they were started.

For one who would interest himself in astronomy, therefore, there is much that is worth while to study even though he have not any observing

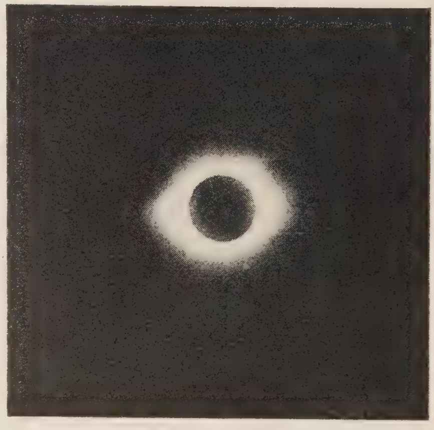


Fig. 1—The total eclipse of the sun on August 31, 1932. A photograph taken with an ordinary pocket camera and enlarged.

Fig. 2—The total eclipse of the moon,—initial partial phases on July 15, 1935. The same camera used for Fig. 1 was held stationary for 1¼ hours and all exposures were made on one film, at 5-minute intervals. The illustration shows the oncoming shadow of the earth and also the apparent curvature of the moon's path.

instrument available. The stars rise and set,—many persons are not aware of this,—and the summer constellations differ from those seen in winter. The sun and moon change their altitudes and the latter regularly passes through its series of phases. The retrograde, or backward motions of the planets are exceedingly interesting to watch, and also the changes in position from year to year.

To augment the information gained by observation, a large number of books and other publications are available so that one may delve as deeply as he wishes and mathematicians, particularly, will find the field a happy hunting ground. There one finds immensity of thought and a demonstration of perfection in mechanical motion by the planets and their satellites as they roll along in their orbits, seeming to sing, with Tennyson's "Brook":—

Men may come and men may go,
But *we* go on for ever.

By means of an ordinary camera, one may record part of what he sees. A solar eclipse gives a real thrill and he may take photographs during one of these rare events, Fig. 1. A lunar eclipse is a weird, colourful spectacle, not so rare, and the initial, or final phases, are very interesting to watch, Fig. 2. A long exposure on the north star shows the other stars circling around it and one then may judge just where the celestial pole actually is located at present,—i.e. slightly more than one degree away from this star.

THE TELESCOPE

Jan Lippershey invented the telescope in 1608 and Galileo, two years later, was first to apply it to astronomical observation and measurement.

The earliest telescopes each consisted of two lenses mounted at opposite ends of a long tube but as the tubes were of small diameter the field of vision was very limited. Nevertheless, with these simple instruments

Fig. 3—The largest objective lens ever successfully completed. It has a diameter of 40 inches, a focal length of 62 feet, and is shown ready for mounting at the Yerkes Observatory of the University of Chicago, in 1895. This lens was made by Alvan G. Clark, left, and Carl Lundin, right.

Galileo observed features of the sun, moon and planets which had not been known before,—epoch-making discoveries which altered the whole study of astronomy. He also made measurements of inter-stellar distances.

Following these early observers, Gregory invented, and Newton developed, the reflecting telescope,—an instrument in which a concave mirror was used, instead of an objective lens (front lens), to produce the real image ready for magnification by the eyepiece. This type of telescope had some advantages over the refractors,—i.e. the first type,—in admitting more light and in not having colour bands surrounding the images, a fault which was found when larger objective lenses had been attempted.

In the days of Galileo and Newton, observers recorded by drawings those objects which they could see through their telescopes. Their studies thus were limited to visible objects and the detail and accuracy of their drawings depended upon the patience and skill of the observer-artist.

With the advancement in the art of lens and mirror manufacture, some of the earlier faults have been overcome. Satisfactory objective lenses have been produced up to a diameter of 40 inches, Fig. 3, and mirrors to a diameter of 200 inches, Fig. 4. With increase in diameter the focal length and size of image have also increased and the effects of diffraction of light in limiting the fineness of detail have been reduced. Many features have

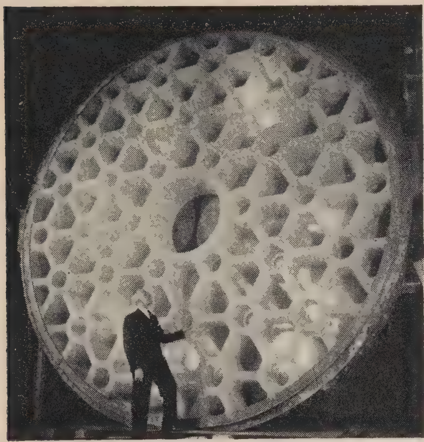


Fig. 4—The Pyrex glass casting for the largest telescope mirror yet attempted: the diameter is 200 inches and the focal length will be 55 feet. The back of the mirror, as shown here, is honeycombed to minimize weight while retaining the necessary rigidity. This is the chief optical element for the new reflecting telescope at the Observatory of the California Institute of Technology on Mt. Palomar.—Corning Glass Works.

been added to the instruments to give greater convenience and accuracy in finding, focussing on and following the object being observed, very accurate clock mechanisms being used for the latter purpose.

Modern astronomy makes use of the combination of three highly refined optical instruments,—the telescope, the camera and the spectograph. With these, records are obtained of the form of a celestial body and of the light and dark lines in its spectrum.

The photographic plate is now a very important factor for it has three features of infinite value in astronomical investigation,—

(a) it can see the unseeable, i.e. it can record details of celestial bodies, nebulae, etc., which shine by invisible ultraviolet light;

(b) it gains detail by long exposures whereas the eye becomes fatigued, and,

(c) it gives much greater accuracy than can be obtained by an observer making a drawing of what he sees.

An example, embodying all of the above features, is shown in Fig. 5; the total exposure was 10¾ hours, on two successive nights. To make such long exposures even the finest clock, or following mechanism, is not sufficiently accurate; the operator must

Fig. 5—The "Whirlpool" nebula in the constellation, Canes Venatici. This photograph, taken at Mt. Wilson Observatory, required exposures on two successive nights for a total of 10¾ hours.

Fig. 6—The 74-Inch Reflecting Telescope, and mounting, at the David Dunlap Observatory of the University of Toronto. The spectrograph is shown, attached to the housing of the great mirror, at the lower end of the instrument. The polar axis, which is directed at the celestial pole and about which the telescope rotates in following a star, may be seen inclined at an angle of about 44° to the floor. The declination axis is about in horizontal position in this illustration, the counter weight being at the near end. (Courtesy Dr. R. K. Young, Director, David Dunlap Observatory).

Fig. 7—Viewing sunspots through a refractor telescope. Caution: A special attachment must be used and great care taken to avoid serious injury to the eye for there is very intense heat and light where the image of the sun is focussed. In this illustration, a clear glass prism, known as the "Herschel wedge", is in use to by-pass about 95 per cent. of the rays, only the small remainder being directed to the eyepiece and light filter.

keep the large telescope directed by observing a "guiding star" in another instrument rigidly attached to the former.

From the spectrographic records, astronomers determine,—

(a) the components of the light of heavenly bodies, which gives information as to the constitution of the stars and nebulae and of the atmospheres of the planets, and

(b) the velocities of motion of the stars, the distances by which certain known lines in the spectrum are separated being used as a measuring stick for speed toward, or directly away from the earth.

The 74-inch reflecting telescope at the David Dunlap Observatory of the University of Toronto, the largest instrument in the British Empire at present, is shown in Fig. 6; at the lower end the spectrograph is attached. This and other reflector telescopes are used almost entirely for spectrum study and to search for very distant faint stars. They may be used for visual observation but this is usually looked upon as an interruption to the more important work for which the instruments have been specially designed.

To the amateur astronomer who possesses a telescope the heavens open wide and present a beautiful, awe-inspiring and ever-varying spectacle of endless interest. What may be seen depends upon the season, the altitude of the object in the sky, the clearness of the atmosphere and freedom from other sources of illumination, and the power and steadiness of the instrument used.

There are many objects worthwhile to see. Probably first in order to be considered should be those revolutionary discoveries of Galileo,—sun spots, Fig. 7, lunar mountains and Jupiter's satellites. Going further, however, and watching through a period of time it is interesting to follow the rotation of the sun, the oscillations, "librations", of the moon, the changing phases of Venus and Mars, and the growth and decay of the snow caps on the latter. Then, over a fifteen-year period, there is the opening and closing of Saturn's remarkable rings.

Out beyond these there are hosts of stars,—single, double, triple and quadruple stars, the components of some of which are only one or two seconds (angle) apart,—and many star clusters and nebulae. There is no limit to the variety for, truly, "one star differeth from another star in glory,"—and the telescope gives further proof of this.

Few persons ever refuse an invitation to see some feature of the heavens through a telescope and probably to all it brings, in some degree, the satisfaction expressed by a young school girl, about eighteen months ago, who, upon viewing Saturn with its rings partly opened, remarked:—"Well, I've seen that in the Geography but I didn't think it was true."

* * * *

In the series of astronomical articles appearing in the Bulletin the writer is endeavouring to draw attention to those features of the heavens which, by study and observations, he has found of greatest interest. Many matters which are highly speculative are purposely omitted; tabulated information, dates and positions, are given only insofar as they may guide an observer to find the objects which he seeks.

Up to the present the following articles have been published in the Bulletin:—

Kitchener and Waterloo Open Lighting Campaign

THE Public Utilities of Kitchener and of Waterloo launched their first efforts in the Lighting Campaign on the first of April. An announcement was made in local papers, accompanied by considerable advertising on the part of local dealers who are very much in accord with the campaign and have combined their efforts to insure its success.

A two-room display showing the

Display at the Kiwanis Festival of Progress, Kitchener.

Lighting display in Kitchener P.U.C. window.

correct and incorrect ways of lighting a living room has been placed in the window of the Kitchener Hydro Building which has attracted a great deal of attention.

Following this, an additional display was installed at the Kiwanis Festival of Progress in which lamps and various lighting effects were demonstrated.

To date the response shown has been very gratifying. Much interest has been aroused and many requests have come in for recommendations for improved home and commercial lighting.

Pipe Thawing

Palmerston, April 22, 1937.

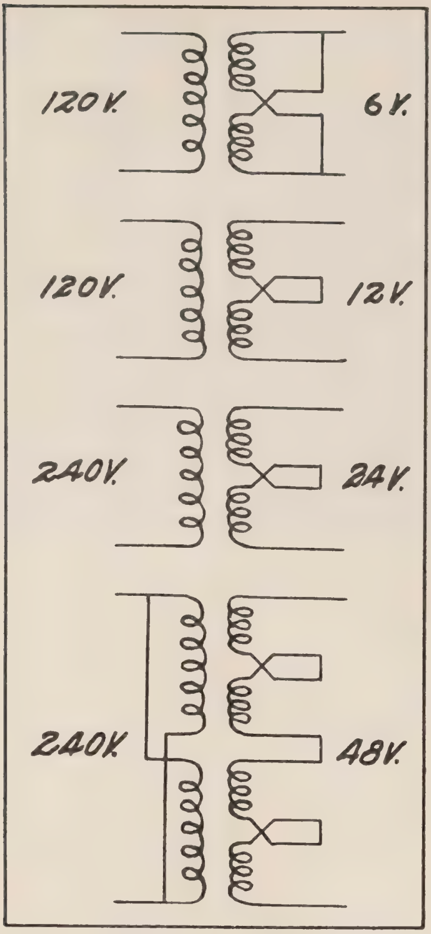
Hydro-Electric Power Commission of Ontario,
TORONTO, Ontario.

Dear Sir:—

I have been very much interested in different "write-ups" that have appeared at different times, and upon reading the one in the March Bulletin, I thought that you may be interested in our method.

We have not had enough "freeze-ups" to warrant the purchase of pipe-thawing equipment. For our purpose we have found the following to work very satisfactorily, and it has the advantage that all that is required are a standard transformer and a few feet of wire, all of which are carried as spares by all municipalities. Also it does not require the handling of voltages higher than 240.

A standard lighting transformer 15 kv-a., 2400-120/240 v., 25 cy. is loaded on the truck and taken to the location. The h.t. is connected to the consumer's service on load side of meter so that consumer pays for the power used to thaw out his service in one of the following combinations. No other charge is made. With this method no rheostat nor other acces-



Connection Diagram
Secondary amperes
15 kv-a. transformer at full load, 60 amperes. Twice load, 120 amperes.
25 kv-a. transformer at full load, 104 amperes. Twice load, 208 amperes.

sories are required, except clip-on ammeter to check current flowing in the pipe: 120 to 200 amps. has been found sufficient to thaw out our services.

This method is only useful for service pipes of course; but we have found it very effective. As a matter of fact we have thawed out a 1½ inch pipe over 100 feet in length, using two transformers, in less than one hour. Some cases require as short as one minute to get the water running.

From the above you will readily see how flexible and simple our method is, without the use of a rheostat.

Trusting that this may be of interest to you and should you feel that others may be interested you are at liberty to pass it along.

Yours truly,
PALMERSTON PUBLIC UTILITIES,
(Sgd.) Ernest E. W. Oke,
Manager.

* * * *

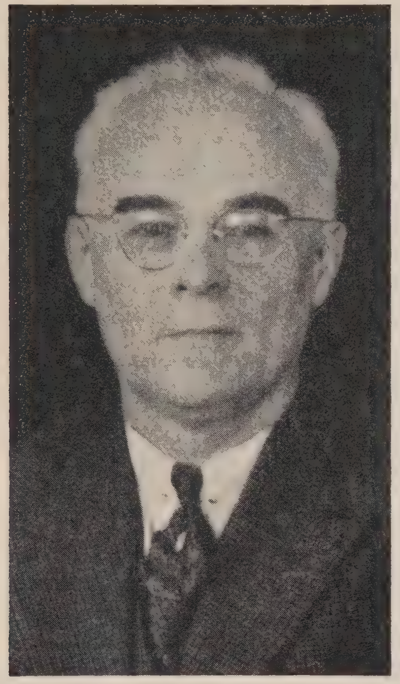
In submitting the above suggestion, Mr. Oke had in mind, no doubt, the precautions to be taken to safeguard against damaging the house wiring and water services and injury to the occupants in the home, as outlined in Mr. Dobbin's paper in the March number.—Editor.

Thomas P. Johnstone, London

Thomas P. Johnstone, a valued employee of the London Public Utilities, passed away on April 11th, 1937, after a short illness.

Mr. Johnstone was born in Annan, Dumfreishire, Scotland, in 1880, coming to Canada in his early twenties. He was employed at Leonard and Sons boiler foundry as clerk and draughtsman for a few years, joining the staff of the City Waterworks as a clerk in May, 1910, at the old City Hall, then located on Richmond Street.

In 1911 the Water Commission took over the distribution of Hydro in London and changed the name of that body to the Public Utilities Commis-



Thomas P. Johnstone.

sion. Mr. Johnstone continued in the employ of the new Commission as Chief Waterworks Clerk and Cashier for both Hydro and Water. This position he held until his death.

"Tommy" will be sadly missed by the staff of the Public Utilities Commission and the public in general.

Dr. F. H. Miller, Aylmer

Dr. Francis Hicks Miller, Chairman of the Aylmer Public Utilities Commission, died at his home on the evening of Friday, April 16, 1937. He had been ill for the past four months from heart trouble and although he seemed to be making great improvement he suffered another attack about a week before his death from which he failed to rally.

Dr. Miller was born in Malahide Township, about a mile east of Aylmer, sixty-five years ago. He attended Aylmer schools and after graduating in dentistry established a practice there. He was an expert dental surgeon and most successful in his profession.

Despite a very busy professional life Dr. Miller found time to make a splendid contribution to public service. He spent some years on the Town Council, but never aspired to be Mayor, although he had many opportunities to accept the position. He was a member of the Aylmer High School Board for many years and also of the Public Library Board.

One of his special hobbies was the Aylmer Public Utilities, where he served on the Commission for more than twenty-five years, and for the greater part of the time as Chairman. It was largely due to his efforts that Aylmer scrapped its municipally-owned power plant and contracted with the Hydro-Electric Power Commission of Ontario for Niagara power, which was first received early in 1918. He was a staunch supporter of Hydro policies and ever ready to advance ideas for the benefit of Hydro users, nor was he one to hesitate in expressing his opinion about matters which he did not think to be in the best interests of the people. To him is also given credit for securing for Aylmer a very satisfactory water supply.

Dr. Miller is survived by his widow, one daughter, one grandson, three sisters, one brother and an aunt, to whom we extend our sympathy.

A.M.E.U. CONVENTION PROGRAMME

Details of the programme of the summer convention of the Association of Municipal Electrical Utilities, to be held at the General Brock Hotel, Niagara Falls, on June 28th, 29th and 30th, 1937, have been practically completed, and the proceedings will be somewhat as follows:—

Monday, June 28th

Evening

Registration

Supper dance, arranged by the hotel. Cover charge $1.00.

Tuesday, June 29th

Morning

Registration

9.30 o'clock—Convention session

"Home Improvement Plan"—By Elliott G. Strathy, District Representative, Home Improvement Plan, Toronto.

"Highway Lighting"—By Dudley M. Diggs, Special Representative of the General Electric Illumination Laboratory, Schenectady, N.Y.

"Meter Symposium"—By Representatives from three meter associations, led by P. B. Yates, St. Catharines, H. R. Hatcher, Galt, and W. Armour, Windsor.

Afternoon, 2.00 o'clock

The delegates will be the guests of Niagara Falls Chamber of Commerce and Hydro-Electric Commission of Niagara Falls, on a bus trip to the Niagara Glen, the Queenston Power House and other points of interest.

Evening, 6.30 o'clock

Convention dinner with O.M.E.A. (Tickets $2.00)

10.00 o'clock

Convention dance, complimentary.

Wednesday, June 30th

Morning

9.30 o'clock—Joint session with O.M.E.A.

"Healthy Comfort"—By James Govan, of Govan, Ferguson and Lindsay, Architects, Toronto, Specialists on Hospitals.

"Rates"—By R. T. Jeffery, Chief Municipal Engineer, Hydro-Electric Power Commission of Ontario.

The Committee on Accounting and Office Administration will hold a Breakfast Meeting during the Convention, date of which will be announced later.

THE
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Hydro's Investments

By T. Stewart Lyon, Chairman, H.E.P.C. of Ont.

(From an address to the Lion's Club, Toronto, on June 17, 1937)

THE total capital used by the Commission in supplying power wholesale to the municipalities and to industrial corporations, which have direct contracts with the Commission, was $297,864,000 at the close of the year. Expenditures of considerably over $3,000,000 on capital account have been made since that time, so that the capital of The Hydro-Electric Power Commission is now somewhat over $300,000,000. This great investment has been made not by the Commission as a corporation owning properties in its own right, but for the most part as trustee for the municipalities of the various systems.

The capital invested in the Niagara System is, of course, enormously greater than that of any of the others. The total investment in the Niagara System, including the Hamilton Street Railway, was $210,746,000 at the end of the fiscal year. The next largest investment was in the Northern Ontario Properties, constructed chiefly to facilitate the distribution of power for the operation of gold and base metal mines. The investment in this case was $31,839,000 at the close of the year. Considerably over $1,500,000 additional capital has been invested or arranged for to provide extensions of plant and transmission lines in the Northern Ontario System since the close of the year.

The money invested in the Northern Ontario Properties has been spent at the risk of all the people of Ontario. The Hydro-Electric Power Commission purchased the plants as the trustee of the Provincial Government and Legislature. Any loss sustained in these operations must be met from the purse of the Province, and any profits derived from them accrue to the Provincial Treasury.

In addition to this capital of over $300,000,000 now at stake in supplying light and power wholesale to the municipalities and to Northern On-

CONTENTS

Vol. XXIV No. 6
JUNE, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

tario, there has been invested by the municipalities for their local distribution systems an amount which at the end of the fiscal year totalled $93,438,000 in Plant Account. Other assets of the Municipal Hydro Utilities, chiefly in the form of Reserve Funds, totalled $22,407,000. The aggregate, therefore, of the capital investment controlled or supervised by the Commission was $413,709,000 at the close of the fiscal year.

The increase in capital investment will be from $5,000,000 to $6,000,000 yearly for an indefinite period, of which at the present time more than half will represent extension of the Rural Power Systems. It is estimated that almost 10,000 new consumers will be added to the users of power in rural Ontario during the present year.

In so great an investment of capital, the only guarantee of its profitable use is to be found in the annual revenues derived from the sale of power, and in the accumulation of reserves which will provide for the return of the capital to the investors at the expiry of the period for which it has been loaned.

The Commission's finances, alike in the matter of income and capital charges, are conducted upon the basis of "pay-as-you-go" annually for cost of power and the accumulation of reserves that will secure the return of the capital within the lifetime of the works constructed and the properties acquired.

The grand total of the Commission's reserves and those of the Municipal Hydro Commissions is $165,470,000. The Commission's share of this total is $90,285,000, and that of the Municipal Electric Utilities $75,187,000. These reserves do not consist solely of invested securities. Some part of the total is represented by a reduction already made in the original indebtedness of the Hydro enterprise to the Government of Ontario and to private investors.

As of April 1st, 1937, out of a total of $207,000,000 advanced by the Ontario Government to the Hydro-Electric Power Commission for construction, a sum of $56,000,000 has been repaid, leaving a net indebtedness to the Province of $151,000,000. This will be reduced from time to time as bonds of the Government of Ontario, issued in part for Hydro con-

struction, fall due. The Commission on the retirement of these bonds will pay to the Province the Commission's share of the debt, obtaining the money either from its Sinking Fund investments or in some cases by a re-issue in its own name of securities.

ANNUAL COST TO CONSUMERS

The annual earnings of the Commission, for power supplied wholesale to Cost Municipalities and to private corporations, including the Gold Mining interests of the North, totalled in 1936, $32,600,000. The Municipal Electric Utilities, distributing this power at retail, collected a total revenue of $34,408,000, of which $20,486,000 represented the amount paid by the Municipal Commissions to the Hydro-Electric Power Commission as the wholesale price of power distributed by the municipalities. Deducting this duplicate entry, it is found that the total cost of power to the consumer during the last Hydro year was somewhat over $46,500,000.

MUCH RURAL WORK YET TO BE DONE

It is estimated that Hydro light and power now goes into four-fifths of the factories and homes of the Province of Ontario. The most backward side of distribution is in the rural areas. Scarcely one-fourth of the farmers of the Province now enjoy the great benefits of electric light and energy.

The recent radical reduction in service charges to farm consumers—from $30.00 to $12.00 a year—has resulted in a greatly accelerated increase in the number of farm consumers, and because of this we are encouraged to hope that within ten years considerably more than half the farms of Ontario will be electrically lighted and serviced with power. Even then we shall still be far behind the small countries of Western Europe where from 80 to 95 per cent. of all rural homes have electric light and power laid on.

ACTIVITY IN NORTHERN ONTARIO

The Abitibi Canyon Development supplies power chiefly to gold mines and to paper companies.

The load for gold and base metal mining in April of this year totalled 77,906 horsepower: in 1936 the corresponding load was 48,980 horsepower. Twenty-three companies mining minerals had direct contracts with the Commission this year as compared with fifteen in April, 1936.

The bulk of the remaining output of the Canyon plant was devoted to the production of steam, used largely by paper mills in the reduction of pulp wood to liquid form. The total amount used under steam boilers in April of this year was 99,196 horsepower, as compared with 69,303 horsepower a year ago. This gives an indication of the very greatly increased activity in the paper mill industry of the North.

The total horsepower generated at the Abitibi Canyon for all purposes during April, 1937, was 177,102 horsepower, on a 20-minute peak. This compared with 118,283 horsepower in April, 1936. The increase for all purposes, therefore, has been about one-third in the course of the year.

It would be possible for the Paper Mills to carry on without the very cheap power supplied by the Commission for their processing work. Steam can be produced from coal much more cheaply today than at any time in the past, because of improved methods.

Cheap Power Makes Mining Possible

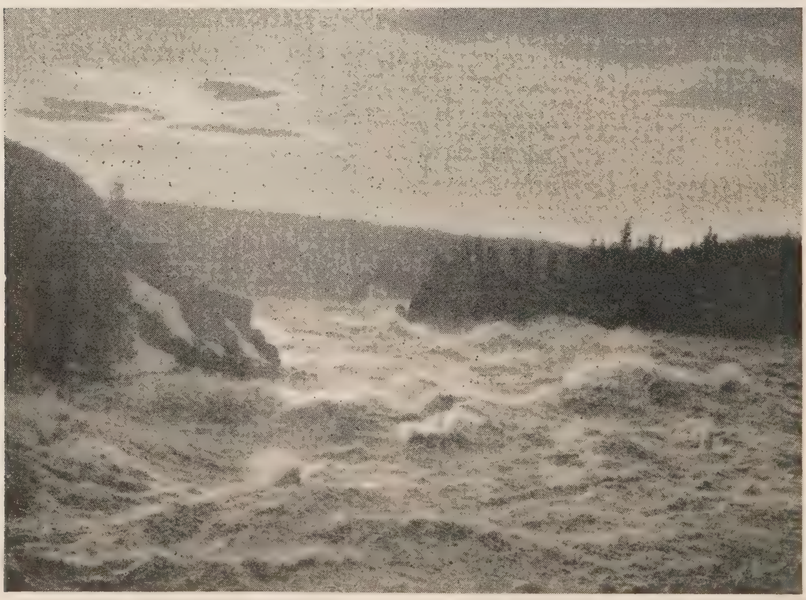
It would be quite impossible, however, for the gold mines to carry on their operations by the use of coal produced steam. The varied forms of the application of power make electricity a far more convenient agent for gold mining operations than steam.

In some of the mines on the outskirts of civilization, where electric energy is not available and where wood has to be burned to produce steam, or oil has to be flown in to operate diesel plants, the cost has been found to be practically prohibitive.

There is one record of a wood-burning development plant in a gold mine near the Albany River producing power at a cost of $280.00 per horsepower per year. The standard price for electric power in the more highly developed portions of Northern Ontario is $32.50 per horsepower for 110,000 volt power and $35.00 per horsepower for voltage ranging down from 44,000 volts.

It is not going too far, therefore, to say that but for the very widespread distribution of electrical energy in Northern Ontario a very large proportion of the mines now operated profitably would be altogether shut down.

The probability is that the further development of water power sites will take the direction of the utilization of small water powers, providing for energy for the mines in the immediate vicinity, rather than of great developments requiring the construction of main transmission lines over hundreds of miles of territory.



Rapids below Smoky falls on the Mattagami river.

Shrinking a Queenston Generator Shaft to Facilitate its Removal

THE Commission has recently employed with success a somewhat unusual method for removing a large generator shaft from its spider. The work was carried out at Queenston where trouble had developed in No. 10 generator. Fortunately an alert operator had noticed that the exciter armature, which is on an extension of the generator shaft, was running out of true to an extent greater than normal. The machine was shut down and when partially disassembled a serious crack in the generator shaft, at the thrust collar keyway, which rendered further operation of the unit out of the question, was revealed. Although technically interesting in itself, it is not the purpose of this article to describe the nature of the damage to the shaft or the type of repair which saved the cost and delay of obtaining a new one. Only one phase of the job, *i.e.* that of removing the shaft from the rotor, will be dealt with.

The Nature of the Problem

A few particulars concerning the rotor and the usual methods of assembly may help to illustrate the problem which presented itself. The rotor assembly consisted of a hollow steel shaft approximately 30 feet 3 inches long and 32.25 inches in diameter, a cast steel spider 5 feet long, a large quantity of laminated iron, and 16 field poles; total weight, 307 tons. The spider hub and shaft were in contact in three step fits each 12 inches in length, and the bore of the spider hub at each step was .009 inches smaller than the corresponding section of the shaft when both were at the same temperature. In the original assembly, the spider alone was heated by means of torches until the diameter of the bore increased sufficiently to enable the shaft to be slipped into it with comparatively little, if any, pressure. When the spider and shaft reached the same temperature, it is estimated that a pressure of 7,000 lb. per square inch developed between the hub and shaft where they were in contact.

Obviously the removal of the shaft presented a more complicated problem. This close, intimate contact between the spider hub and shaft would naturally encourage a transfer of heat from one to the other and tend to defeat any attempt to expand the spider without expanding the shaft also. Slow, gradual heating would be quite useless unless accompanied by other measures to control the shaft temperature. Furthermore, when, as in this case, metallic surfaces have been in contact under high pressure for a long period of time, there is a tendency for them to adhere to each other, increasing the initial friction.

The presence of the field poles added to the difficulties. On account of the insulated field coils, the temperature of the outer ring was limited to 85 deg. cent. and at this temperature it would naturally tend to restrain the outward movement of the hub and spokes under the influence of higher hub temperatures, placing the spokes in compression. Nevertheless, as the labour and loss of time incidental to removing the field poles, dismantling the laminated iron, and subsequent reassembly, would have been very considerable, it was important to avoid doing so.

Calculations of the difference in temperature needed between the spider hub and the shaft, to free the one from the other (allowing for roughness and errors in machining) indicated that it would probably be in the neighborhood of 55 deg. cent. Accepting this estimate, although there was some uncertainty as to its accuracy, the problem resolved itself into one of determining the best method of obtaining that temperature difference and putting it into effect.

Owing to the mass of the members and the confined space in which to carry out heating operations, the usual method of making a quick application of local heat to the hub appeared to be a difficult and even a somewhat dangerous one. The use of large torches as heat sources was very unattractive, if not entirely impracticable. In the end, it appeared that specially designed charcoal baskets, with controlled air blast, capable of developing 13,000 B.t.u. per hour per square foot of contact and suitable for use between the spokes would furnish a practicable heat source and would be preferable to other heating methods.

The only feasible alternative to expanding the hub was, of course, shrinking the shaft and as the 8-inch diameter hole throughout its entire length furnished a very convenient means of circulating a low-temperature liquid, attention was seriously directed to the practicability of cooling operations. Carbo-ice afforded an excellent commercial cooling medium and although adequate data as to its characteristics when used in conjunction with cooling liquids was lacking at first, this information was readily obtained from the Dry Ice Company of New York and Carbo-Ice Limited of Leaside, Ont.

While the irregular shape of the rotor and the uncertainty as to the rate of heat transfer across the contact surfaces combined to make mathematical computations difficult and of questionable reliability, nevertheless the best calculations which could be made appeared to indicate that a combination of rotor heating and shaft cooling constituted the safest and best means of relieving the pressure between shaft and hub to an extent which would permit the removal of the former without removing the field poles and with the facilities which were available.

Dr. Smith of Carbo-Ice Limited took a keen interest in the problem and consulted the Physics Department of the University of Toronto. At their instigation, a scale model was constructed at Queenston and tested at the University. As these tests confirmed the calculations and opinions already partially formed, a decision

was reached to cool the shaft and to use, as a refrigerant, alcohol and carbo-ice. The tests also furnished an indication as to the quantities of carbo-ice required, and thus avoided undue wastage.

An Incidental Difficulty

In passing, brief reference to an incidental feature which called for solution at the very outset may be of interest. To lift the assembled rotor (307 tons), two 150-ton cranes must be brought into play through an equalizing yoke which attaches to the shaft. With the shaft free, there is no means of lifting the rotor. As the order of the step fits was such that the shaft could not be lifted vertically upward out of the rotor (the coupling would also have prevented this) and as the rotor could not be moved after detaching the shaft, it was clearly necessary to devise means of lowering the shaft. To this end a special structural steel cradle was designed, and assembled over a hoisting hatchway and the rotor was placed on it in such a way that the shaft could be lowered, moved to one side clear of the rotor, and again raised into the erection room.

Heating and Cooling Apparatus and Preparations for Final Operations

As the carbo-ice had to be obtained from Toronto and a miscarriage of plans might easily involve the loss of the entire shipment, plans were worked out in detail and with great care; they finally called for:—

1. A very gradual heating of the rotor until the laminated iron reached a maximum of 80 deg. cent.

2. A simultaneous cooling of the shaft by water at approximately 4 deg. cent.

3. A final rapid cooling of the shaft using alcohol and carbo-ice as a refrigerant.

4. The quick application of a large amount of heat to the spider hub in case items 1 to 3 did not ease the shaft sufficiently to enable it to be removed. A battery of eight specially-designed charcoal baskets of a type previously described were held in reserve for this purpose. They were capable of producing 300,000 B.t.u. in about twenty minutes and this amount of heat was expected to increase the hub temperature 76 deg. cent.

To carry out these plans, the rotor was housed in a small chamber insulated by corrugated asbestos paper and equipped with a number of electric space heaters of 10 kilowatts capacity. Close beside, a 750-gallon steel tank, 3.5 feet in diameter and 11 feet high, insulated by kapok mattresses and equipped with coarse and fine strainers for carbo-ice, was set up. An insulated connection was provided from the bottom of this tank to the bottom of the generator shaft through a 200 gal. per min. centrifugal pump and a return from the top of the shaft to the tank completed the circulating system. Flexible rubber hose was used for part of both connections to permit the shaft to be moved clear of the fits without interrupting the cooling process. A stove-pipe vent from the tank to a point outside the building was added to dispose of the large quantities of carbon-dioxide gas which, it was thought, might also be

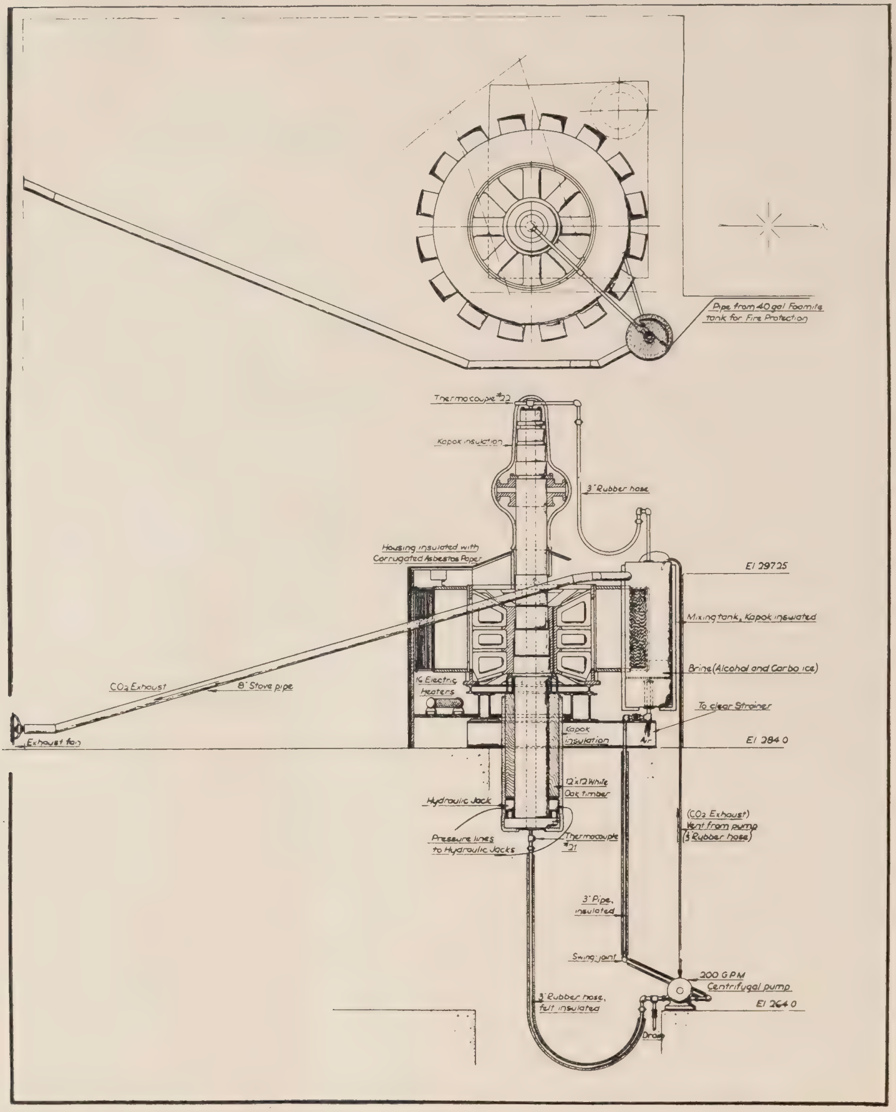


Fig. 1—Diagram of general arrangement.

mixed with fumes of alcohol constituting a fire hazard.

Thirty-two thermo-couples were distributed so as to give an accurate indication of the temperature of the rotor, shaft and cooling liquid, and, finally, two 75-ton hydraulic jacks were placed so that they could exert a thrust between shaft and rotor tending to move the shaft downward, and a 400-ton jack was held in reserve. The arrangement is shown in Figs. 1 and 2.

Five days were devoted to the pre-

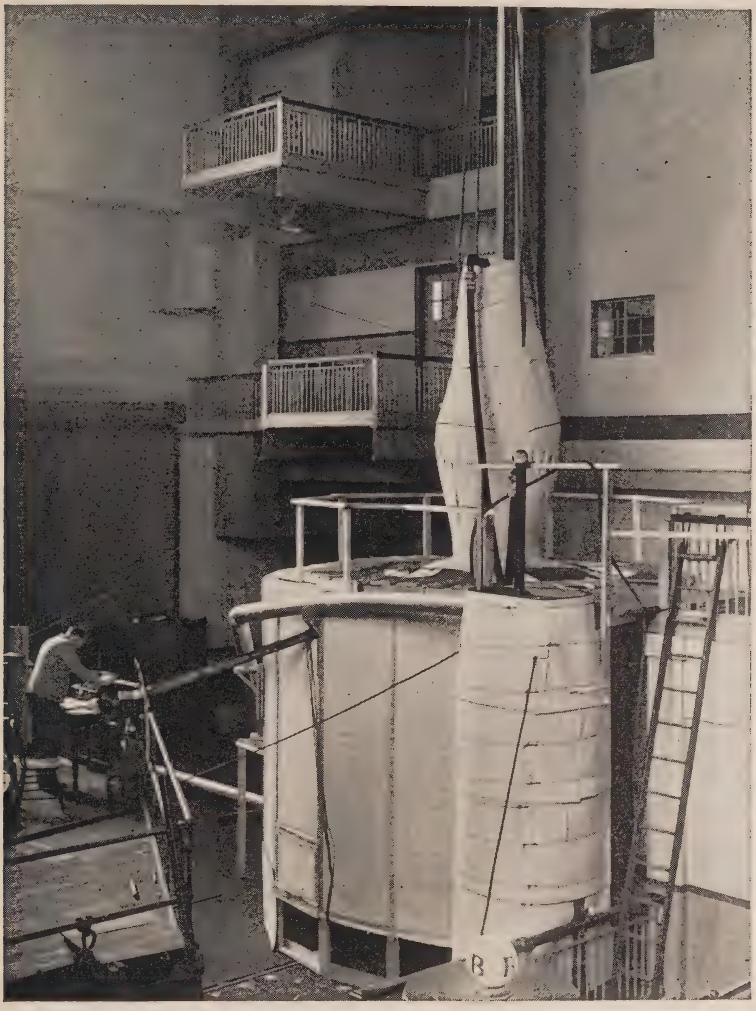


Fig. 2—Photograph showing general arrangement and exterior insulation. Vented tank for refrigerant in foreground. Instrument bench at the left.

liminary gradual heating of the rotor; during this period the input to the electrical heaters averaged 55 kw. and the shaft temperature was kept down by water at about 4 deg. cent. which was passed through it at a rate of about 25 gallons per minute. At the end of that time the laminated iron ring reached a temperature of 84 deg. cent., the hub 50 deg. and the shaft 28 deg. Thus a temperature difference of 22 deg. cent. was attained between the shaft and the hub.

Under the foregoing conditions, a thrust of 200 tons did not move the shaft.

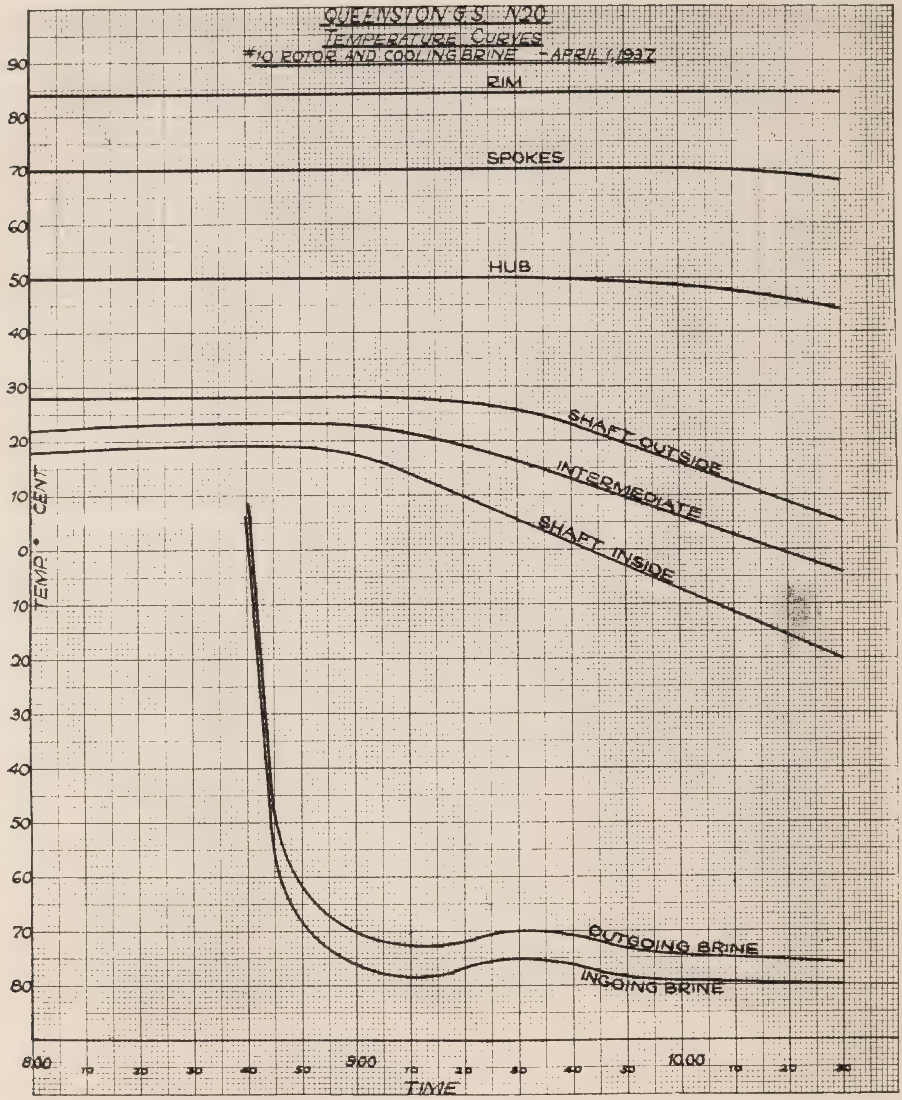


Fig. 3—Record of temperatures. Note that at the very lowest temperatures the indications are about 6 deg. cent. in error on the low side. The error disappears in the neighborhood of zero centigrade.

Intensive Cooling Operations

On Thursday, April 1st, with 300 gallons of alcohol circulating in the cooling system at a temperature of approximately 6 deg. cent. and a rate of 200 gal. per min., six tons of carbo-ice on hand in 200-pound insulated cartons, the two hydraulic jacks pumped to exert a thrust of 150 tons on the shaft, and the shaft slung to

the crane hook in readiness for lowering, intensive cooling operations were commenced. Under these conditions, about ½-ton of broken carbo-ice was put into the tank with marked effect. In about five minutes the temperature of the refrigerant in the tank dropped 55 deg. cent. and in thirty minutes it approximated the minimum attainable with dry-ice and alcohol, namely –72 deg. cent. Unfortunately the equipment which was improvised to measure the very low temperatures gave indications which were very nearly 6 deg. cent. in error, on the low side, at the lowest temperatures; allowance for this must be made when interpreting the temperature graphs presented in Fig. 3.

The carbo-ice had to be fed into the tank with care until the temperature of the alcohol approached the lower limit. During the early stages, when the alcohol was relatively warm, excessive "boiling" occurred if it were added too rapidly, but at very low temperatures this difficulty disappeared and it became a simple matter to maintain a temperature close to the minimum for this refrigerant.

Within an hour, the jacks were observed to have lost their pressure, indicating that without the use of local auxiliary heat on the hub the shaft had moved.

The movement which had occurred so unobtrusively in advance of expectations was continued as rapidly as the jacks could be operated; however, such efforts proved to be unnecessary, for, within another hour, the shaft was quite free and, unaided by jacks, it was lowered clear of the fitted portions.

It is interesting to note, as will be seen by reference to Fig. 3, that the temperature difference between the shaft and spider hub at the time the shaft first moved under the influence of the jacks was approximately 34 deg. cent., and that when a difference of 48 deg. cent. had been attained, the shaft was quite free. This agreed reasonably closely with the estimate of 55 deg. cent. for free movement. At the time the shaft was moving freely, it is estimated that its diameter had been reduced 18/1000 of an inch and that it was very nearly 9/1000 of an inch smaller than the bore of the spider hub instead of 9/1000 of an inch larger as it was when both were at the same temperature.

While the method employed was very successful and safer and more satisfactory than heat treatment alone, there can be no question but that the application of local heat by means of charcoal baskets, while circulating water at 4 deg. cent. through the shaft, would have enabled the shaft to be removed with the aid of jacks.

In conclusion, it is fitting that acknowledgment should again be made of the voluntary assistance given by Dr. Smith of Carbo-Ice Limited, and the Physics Department of the University of Toronto.

Reconstruction in Palmerston

THE accompanying illustrations are of Main street in the town of Palmerston, where the Public Utilities Commission has been carrying on a three-year reconstruction program. This involved the rebuilding of the entire electrical system, the rerouting of pole lines through the business section, and the erection of ornamental street lighting on three streets in this section, extending same through the residential sections on Main street.

Fig. 1—Looking east on Main street, before improvement.

Fig. 1 shows a section of Main street before beginning the reconstruction program. Fig. 2 shows the same section after the work was completed excepting removing the telephone poles shown on the right-hand side. The improvement also includes the removal of these poles. Fig. 3 is a night view of the same section after reconstruction.

In reconstructing and bringing the distribution system up to modern standard and capacity, conditions developed due to the layout of the town that were somewhat unusual and also some new ideas regarding construction and circuits were applied. Descriptions of such, however, must be omitted here due to lack of space.

Fig. 2—Same section of Main street as Fig. 1, after improvement—telephone poles at right to be removed.

Fig. 3—Night scene on Main street, after improvement.

The Manufacture of High Voltage Porcelain Insulators

By J. M. Somerville, Canadian Porcelain Company Limited, Hamilton, Ontario

(From an address to Toronto Section A.I.E.E., January 22, 1937.)

THE transmission and distribution of electric power today demands reliable insulation capable of withstanding potentials ranging from 550 to 290,000 volts for indefinite periods.

Wet process porcelain, first used for the fabrication of insulators on this continent by Fred M. Locke in 1893, is the most satisfactory material developed for this service to the present time. It is impervious to moisture, resists the corrosive action of industrial fumes and remains unaffected by sunlight. It develops sufficient mechanical strength to carry the load of heavy cables and withstand the thermal stress arising from rapid temperature variation. When incorporated in insulators of proper design porcelain shows no deterioration under the dielectric stress created by high voltage.

Wet process porcelain is a homogeneous mechanical mixture of ball clay, china clay, feldspar and flint. Chemically these materials consist of silica and intricate combinations of silica, alumina, potash and soda.

Flint, commonly known as quartz, is silicon oxide SiO_2. In some localities it occurs in pure form in extensive veins and may be found surrounded by igneous rock. Where the action of glacial streams has broken down these veins, deposits of quartz sandstone can be found. Such deposits occur in Pennsylvania, Michigan and Quebec, and if at least 98 per cent. pure they form ideal sources of flint. For ceramic consumption the sandstone is washed free of earthy matter, dried,

ground, passed over a magnetic separator for the removal of iron, and then subjected to a final grinding process until 100 per cent. of the material will pass through a 200-mesh screen.

Feldspar is a complex mixture of silica, alumina and potash or soda. Potash spar is of chief interest for the production of electrical porcelain, in the pure form it is represented by the formula K_2O Al_2O_3 $6SiO_2$. Feldspar is very plentiful but unfortunately in the majority of cases it is mixed with quartz, mica, iron, tourmaline and other impurities rendering it unfit for ceramic purposes. Occasionally it is found in a reasonably pure form in veins or dykes which fill large cracks in granite. Such deposits at Buckingham, Quebec, and Verona, Ontario, furnish the industry with a high grade potash feldspar. The broken lumps are sorted for first class material and then subjected to a process or preparation very similar to flint. A 200-mesh screen will pass 80 per cent. of the final grind usually selected for the ceramic industry.

Ball clay is a hydrated aluminum silicate, generally the product from the weathering of feldspar dykes. The weathering action leached the potash and soda from the feldspar, leaving alumina and silica in a form which combined with available water to form a colloidal aluminum silicate, the colloidal properties imparting plasticity and adhesive powers to the mixture. Rain carried this product to swollen streams where it mixed with organic matter which further enhanced its plastic qualities. Where such streams entered quiet ponds or marshes the water slowed sufficiently to allow the clay to drop out, forming large deposits which finally filled these ponds with clay. As time passed on the river beds shifted, leaving the clay deposits covered with debris and earthy matter, where they are now found at depths from ten to one hundred feet below the surface of the earth. Ball clay, which fundamentally is an amorphous form of kaolinite, Al_2O_3 $2SiO_2$ $2H_2O$, is never found in pure form but intermixed with small proportions of calcite, limonite, pyrite, gypsum and organic matter. The quantities of impurities present largely determine the characteristics of each clay deposit and allot it to some particular sphere of usefulness in the ceramic industry. Ball clay deposits found in England and the State of Kentucky are particularly well adapted to the manufacture of electrical porcelain.

China clay is also an amorphous form of kaolinite but less plastic than ball clay and comparatively free from organic and mineral impurities. In preparation for industry it is washed free of mineral and organic impurities and then classified in large settling basins. England provides the chief source of china clay although deposits recently discovered in northern Ontario offer future possibilities.

The component materials of porcelain bear a striking chemical resemblance to each other, however their physical nature gives each an essential part in the complete mixture. Feldspar acts as a vitreous bond in the fired ware, beside supplying elements necessary for the transformation which occurs during firing. Flint acts as a backbone to the porcelain body, lending strength which helps to

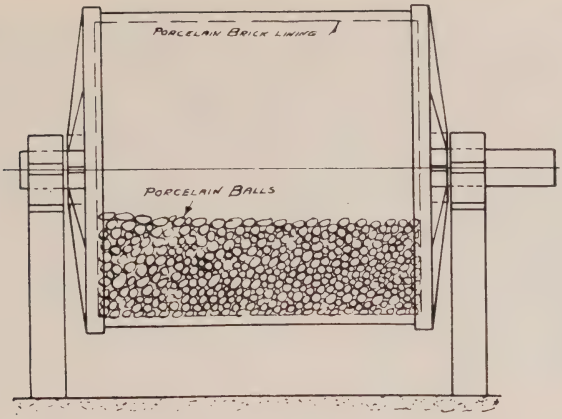


Fig. 1—Ball Mill.

prevent deformation at elevated firing temperatures. It also lowers the vitrifying temperature of the feldspar and enters to some extent into a complex reaction with it during firing. Ball clay forms the plastic bond which binds the other materials together, making it possible to form and machine intricate shapes before firing. It, and the china clay also provide alumina which aids vitrification and enters into the crystal structure resulting from firing at high temperature. The quality of the ball clay and its colloidal nature not only determine the strength of the body before firing, but also contribute greatly to its mechanical strength, dielectric characteristics and resistance to thermal stress after firing.

Wet process electrical porcelain may be made from the following pro-

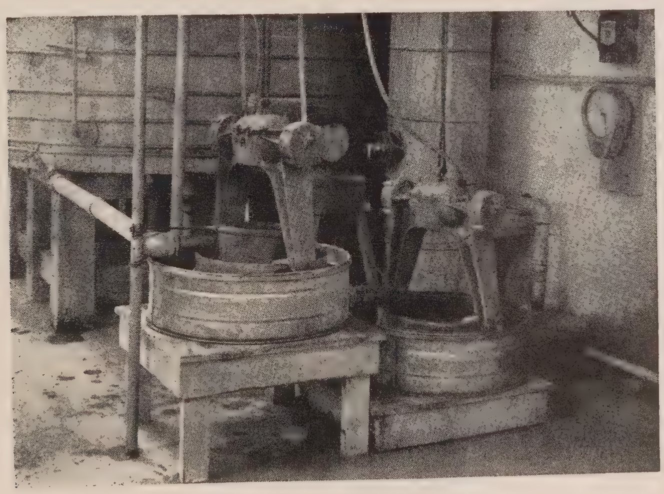


Fig. 2—Electric Slip Lawns.

portions of raw materials: ball clay 25 per cent., flint 25 per cent., feldspar 25 per cent., china clay 25 per cent. The clay is treated several days before mixing to develop its plastic qualities. It, and the remaining raw materials are then weighed out with sufficient water for mixing and placed in a ball mill, where they are subjected to a grinding and mixing operation lasting from two to eight hours, depending upon the degree of fineness desired. (See Fig. 1.) The mixture emerges from the ball mills in a liquid form termed clay slip. A careful check of the *Ph* value of the mixing water and variations of mineral content is necessary to hold the slip characteristics constant from day to day.

The slip is next passed through vibrating wire screens or lawns which remove large particles of lignite and other lumpy substances originating in the ball clay. It is then exposed to powerful magnets which remove any magnetic materials present in the liquid. Quart samples of the slip are selected at this stage and weighed to 1/100 of an ounce for density determinations. The density and viscosity of the slip has a marked effect on the characteristics of the plastic clay formed from the slip in the filter presses, for this reason variations in density and viscosity must be avoided.

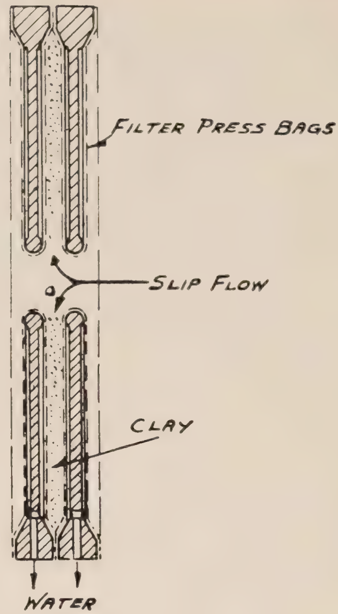


Fig. 4—Arrangement of Bags in Filter Presses.

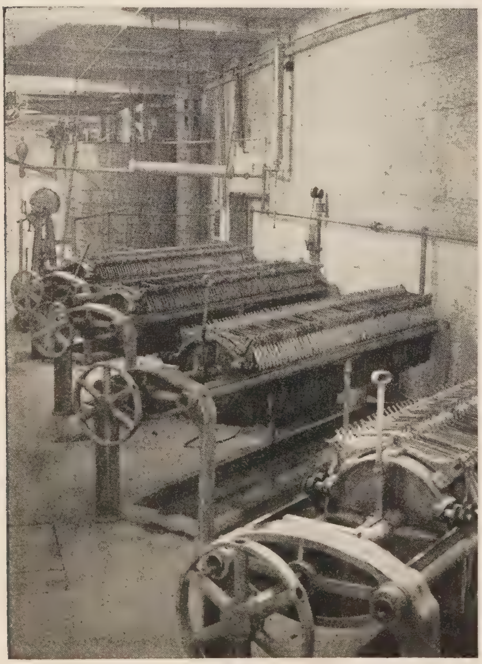


Fig. 3—Filter Presses.

If the slip is satisfactory it is next pumped to the filter presses. Here the clay is retained by cotton duck filtering or press bags while the water is al-

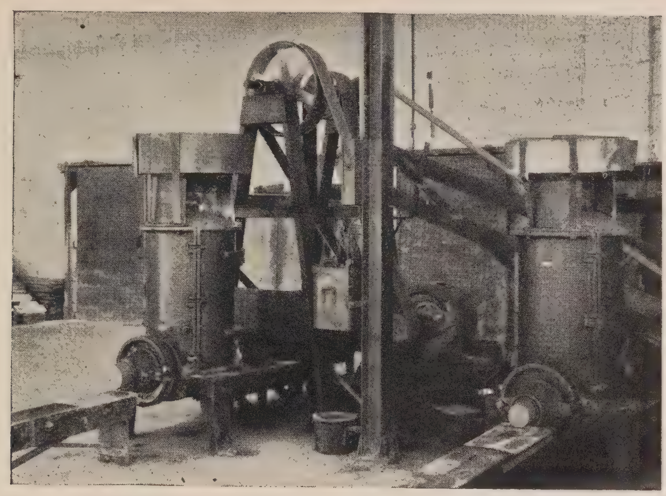


Fig. 5—Pug Mills.

lowed to pass on. As pumping continues the clay gradually builds up into slabs termed filter cakes. To avoid segregation of the component materials and insure proper plasticity of the clay in the filter cakes a strict pumping schedule of pressure in relation to time must be adhered to. When the press fills with clay the pressure is removed and the clay slabs taken from the press. (See Figs. 3 and 4.) Each slab is checked for plasticity and density, if satisfactory it passes to the clay cellar where it undergoes an ageing process, which improves the plasticity and tenacious characteristics of the clay besides allowing it to acquire uniformity throughout. During the ageing process the humidity in the clay cellar is maintained near saturation to prevent the clay from drying.

In the next stage of production, clay from the cellar is cut and placed in a pug mill consisting of a vertical set of blades or cutters pitched similar to a worm. These cut the clay and force it downward into a horizontal worm which in turn extrudes it at high pressure through the nozzle of the mill. The blades on the vertical feed are maintained at an irregular pitch to eliminate any tendency to produce spiral laminations in the clay. As the clay leaves the mill nozzle in cylindrical form it is cut off in convenient lengths for the production of various size insulators. Clay tubes and strain insulator blanks may also be extruded from the pug mill by fitting it with nozzles adapted to the purpose. (See Fig. 5.)

The pieces from the pug mill are next rolled and shaped by hand to eliminate the possible presence of folds or laminations. They are then packed tightly into plaster of paris moulds ready for pressing or jolleying into insulator parts. The fit of the hand shaped clay slug in the mould is very important as a loose fit may allow entrapped air pockets or folds to exist in the finished insulator part. Plaster of paris moulds used for this

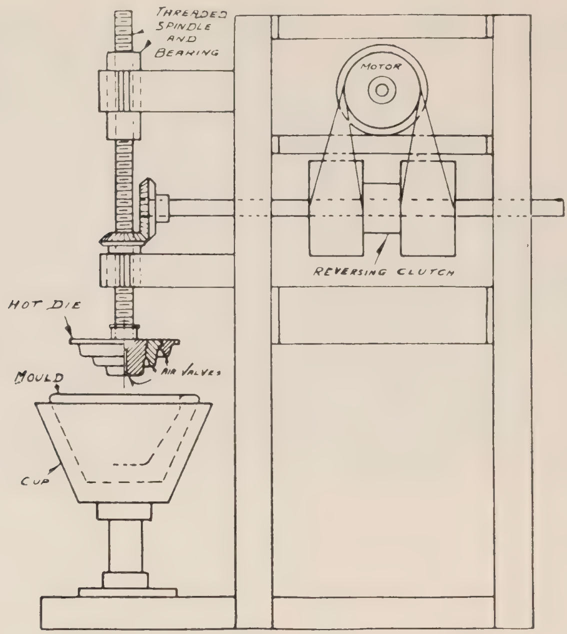


Fig. 6—Hot Press.

operation are carefully cleaned and brought to the proper moisture content before the filling operation. The absorbent properties of the dry plaster are used to assist in drying the clay pieces when first formed; however, if the plaster is too dry, the resulting rapid absorption is likely to damage the clay piece.

Suspension insulators and small pin type insulator shells are formed in a hot press. The mould containing the clay is placed in the press which is semi-automatic in operation. A hot metal plunger or die then descends into the clay with a revolving motion, subjecting the clay to a high pressure, which causes it to assume the form of the mould and plunger. At the point of maximum downward travel the plunger reverses rotation and withdraws from the mould leaving a formed insulator or shell. The metal plunger is heated and provided with an elaborate set of air valves to allow it to release from the clay upon reversal. The heated metal surfaces create a thin wall of steam between the plunger and the wet clay which overcomes the tendency of the plastic clay to adhere to the plunger surface. Simple types of thread can be produced in pin type insulator centres or shells by incorporating a metal master thread in the plunger centre. The two main essentials of the plunging operation are to obtain an evenly pressed piece, in which the clay is distributed with even density at high pressure without the creation of folds, and then to allow the plunger to release from the surface of the piece without sucking. Many rather obscure faults in the finished insulators which cause

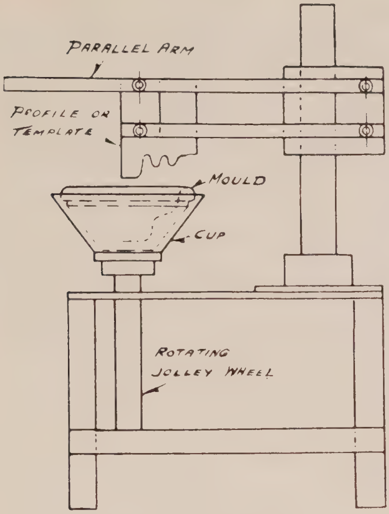


Fig. 7—Jolley.

low mechanical strength, poor thermal resistance and low dielectric strength can now be traced to plunger sucking. For this reason careful attention must be given to the contour of plunger surfaces and the location of air release valves. Sufficient heat during operation must be applied to the plunger for the production of steam for release purposes, but overheating which will readily damage the clay surface is to be avoided.

Larger pin type insulator shells are made on a jolley which resembles a potter's wheel. The clay in the mould is placed in a rotating cup, a male template designed to the shape of the finished piece is then slowly lowered into the rotating clay, where with the assistance of the operator's hand it spreads the clay and finally imparts the desired shape to it. The jolleying operation requires a skilled operator, as suitable compression of the clay in the finished piece is only obtained by the skilful use of his hand in feeding it under the template. (Fig. 7.)

Jolleyed and pressed insulator parts remain in the moulds under the influence of a moderately warm dry atmosphere for periods from eight to twenty-four hours. During this time the clay dries to a state termed leather dry, shrinking sufficiently for easy removal from the mould. As regards shrinkage it may be noted that the shrinkage from the wet stage of the formed pieces to the dry stage just before glazing is 9/16 inch to the foot. From the dry stage to the fired stage when the porcelain is finished there is a further shrinkage of 1⅛ inch to the foot, giving a total from the wet stage to the finished piece of 1-11/16 inch to the foot. Leather dry pieces must be carefully handled to avoid distortion with its tendency to develop internal strains.

Following removal from the moulds the insulator parts are placed on rotating forms where rough edges and other superfluous portions are removed. A moist sponge is then used to impart a finished surface to all the trimmed parts. Trimmed parts are next placed on racks for storage in the humidity dryers.

Large entrance bushing parts, potheads, cutout boxes and other intricate porcelain pieces are cast from liquid clay slip. This process so differs from ordinary methods of production that it justifies further consideration before continuing with the manufacturing process as a whole. Ordinary clay slip as used for the production of clay in the filtering operation has too great a water content for casting thick sections, due to its ex-

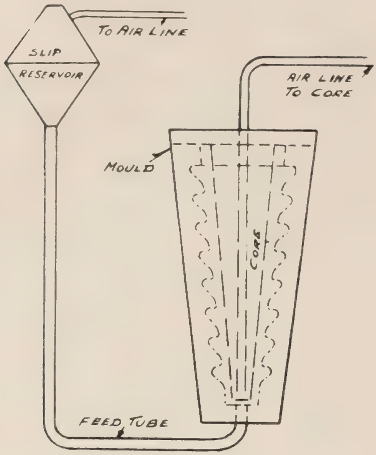


Fig. 8—Casting.

cessive shrinkage upon solidification. Casting slip is made from a milled mixture similar to the regular mix but having a higher flint content and its density raised to 72 ounces to the imperial quart. At this density the mixture would not remain liquid but for the addition of the deflocculating agents, silicate of soda and sodium carbonate, in small quantities. These deflocculants react with the colloids of the clay in a manner which increases their mobility to the point where a mixture which would ordinarily be solid is kept liquid with such a small water content that shrinkage upon solidification is reduced to a minimum. The casting slip is forced into sealed plaster of paris moulds under pressure, where precipitation of the slip occurs as the mould absorbs the water. Two methods of casting are employed, core casting and drain casting. In core casting a plaster of paris core having a perforated pipe imbedded in its centre is placed in the mould. The clay forms between the core and mould walls as the slip is pumped in. When precipitation is complete, compressed air is applied to the pipe in the core, from which it passes through the plaster and releases the clay from the core surface, thus making it possible to withdraw the core. (Fig. 8.) In drain casting no core is used, and the complete mould is filled with slip under pressure; then when sufficient time has elapsed to allow precipitation of the clay to the desired thickness the pressure is removed and the surplus slip drained out of the mould. Cast pieces are allowed to remain in the moulds until they dry enough to support their own weight. They are then removed, trimmed, and allowed to continue drying under canvas covers to protect them from direct draft.

All pieces regardless of the method of firing must be given a final drying in the humidity dryer. The moist ware is closely stacked in large drying rooms which are then closed tightly

Fig. 9—Operator Turning Transformer Bushing.

to prevent the escape of moisture and the temperature raised by means of steam heating coils. As the temperature increases the humidity in the dryer rises to a point approaching saturation, which retards drying until the clay pieces are evenly heated throughout. Ventilators are then opened and the moisture allowed to slowly escape until the clay ware is completely dried. The drying operation requires approximately one hundred and twenty hours at a maximum temperature of 160 degrees fahr.

After drying each piece is inspected for cracks, warping or improper dimensions before passing to the glaze table. Small transformer bushings and busbar insulators are turned and drilled from dried clay blanks. Clay turning is done in the manner of wood turning with the clay revolving at high speed. Cutting is accomplished by means of carbaloy-tipped tools guided by hand in some cases and by metallic templates in others. It is important that the clay pieces be driven at the highest possible speed in order to attain a smooth surface free from incipient cracks.

Before glazing all adhering dust is removed from each piece by means of powerful air jets and the surfaces wiped with a moist sponge to prevent the formation of pinholes in the glazed surface before and during firing. Surfaces which must be kept free from glaze are covered with molten paraffin. Each piece is then quickly immersed in liquid glaze and then placed on drying pins to await the sanding operation. Large pieces too cumbersome to dip are glazed by means of a spray gun.

Insulator glazes mature at the top temperature at which the porcelain is fired, they must be hard, resist rapid thermal changes without crazing or chipping and withstand the action of corrosive industrial fumes. They are composed of the following materials: feldspar, ball clay, china clay, calcium carbonate, and manganese, with the addition of various colouring agents, dictated by the final colour of each particular glaze. Lead or other poisonous substances are not used in insulator glazes.

It is of utmost importance that a glaze be selected that properly fits the porcelain body. If the glaze shrinkage is greater than the body upon cooling to normal temperature, the glaze will be subject to considerable tensile stress, which will result in cracking or crazing when the porcelain is subject to the normal temperature variations of service. This stress not only effects the glaze, but can start incipient cracks in the surface of the porcelain, which will progress to serious thermal cracks as the insulator ages. A glaze which has considerably less shrinkage than the body will be subjected to compression stresses, which will cause spalling or chipping of the porcelain surface when the piece is exposed to rapid temperature changes. Recent research indicates that it is advisable to apply a glaze which fits the body in such a manner that it is under slight compression at normal temperature. With such a combination the glaze resists mechanical stress to a greater degree, in that it allows higher tensile strain on the surface of the porcelain piece without the formation of surface cracks, which

rapidly strike into the body and cause failure. This glaze is never under sufficient compression stress to cause surface spalling or chipping.

When the glazed pieces are dry the surfaces which require sanding are covered with an adhesive material which holds the sand in the desired place. The sand is then applied while this material is wet. This sand, which later provides the means of gripping the porcelain with Portland cement for the attachment of hardware, securely bonds itself to the porcelain surface during firing by fusion of the undercoat. It is made from screened porcelain, fired, crushed and graded, it will pass through a 14-mesh screen but will remain on a 20-mesh screen. A close inspection under intense light for glaze or sand faults follows the sanding operation. Accepted insulator parts are then placed on padded trucks for removal to the kilns.

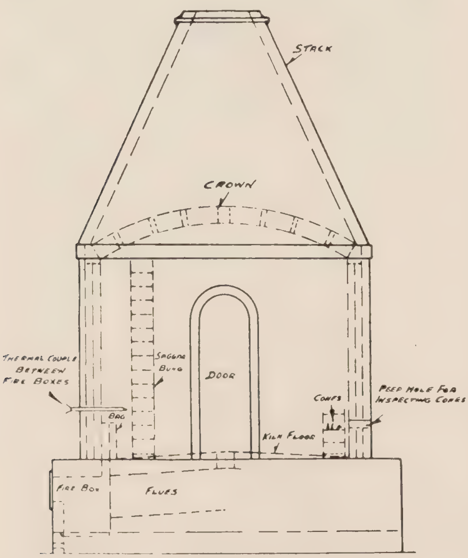


Fig. 10—Kiln.

Fig. 11—Interior of Kiln During Loading.

The best established method of firing electrical porcelain employs the periodic kiln fired with coal, oil or gas. Each piece placed in the kiln is set inside a sagger pot composed of refractory fire clay, which removes all weight from the insulator parts during firing, other than the weight of the individual piece. The sagger pot also protects the glaze from the erosive action of the kiln fire. The pots are stacked in vertical piles termed bungs, the joints between the pots are sealed with strips of wad clay. Bungs are arranged at fixed distances apart so that the hot gases from the kiln fire will have ready access to each sagger. To overcome the friction between the base of heavy insulators and the sagger bottoms set up by the shrinkage of the porcelain during firing, large insulators are set on shrink plates of unfired clay which in turn rest on a layer of flint sand in the

sagger bottom, thus avoiding internal strains which tend to crack the shrinking insulator during firing. (Figs. 10 and 11.)

When kiln loading is completed the door is carefully sealed and the fires started. The majority of circular periodic kilns have ten fireboxes spread equally around the circumference of the base or kiln hob. Fuel is supplied to each firebox in measured quantities to insure even heating and temperature progression at a pre-determined rate. Each kiln is equipped with seven thermocouples, five of which are located around the kiln wall at points between the fireboxes at a height of thirty inches above the kiln floor. The sixth thermocouple is located in the kiln wall about eight feet above the floor. The seventh couple is placed at the kiln top in a hole in the centre of the kiln crown. Thermocouple leads are carried to a pyrometer station where correction for cold end temperatures are made and the temperature of the thermocouples recorded. Pyrometer readings serve to check the progression of temperature throughout the kiln enabling the fireman to maintain the various sections at even temperature and to adhere to a pre-determined schedule of kiln firing. Pyrometric cones consisting of special clay mixtures which fuse and bend over at pre-determined temperatures are also placed at important locations in the kiln where they may be observed through peepholes during firing. The cones are used in conjunction with the pyrometers for kiln control, they introduce a time and temperature reaction element which determines the finishing point of firing. Pyrometric cones are numbered, the number indicating the temperature at which fusion and bending takes place. If it is desired to fire a kiln until No. 10 cone bends half over, a small group of cones numbering 8, 9 and 10 are placed at each observation point. The Nos. 8 and 9 cones indicate the approach to the critical finishing temperature of 2,300 degrees fahr. at which No. 10 cone bends. Electrical porcelain is fired to temperatures ranging from that shown by No. 10 cone (which commences to bend at 2,280 degrees fahr.) to cone 12 (which bends at 2,390 degrees fahr.) depending upon the nature of the raw materials from which the porcelain is made and the structure desired in the fired material. Heat must be applied slowly during the early part of the firing to allow the escape of any moisture present, an even distribution of heat throughout the brittle pieces and the oxidation of organic matter from the ball clay. At a temperature from 850 to 1,400 degrees fahr. the water of combination is driven off. At temperatures beyond 1,600 degrees fahr. vitrification commences, the feldspar begins to fuse and combine with the flint, the aluminum silicates break down and re-crystallize to mullite crystals $3Al_2O_3$ $2SiO_2$ as the heat progresses. These reactions are accompanied by a marked shrinkage of the porcelain pieces. The glaze also fuses, forming a dense smooth coat over the surface of the porcelain. At a temperature of 2,300 degrees fahr. firing is completed, and the kiln doors are sealed to prevent cool air drafts from sweeping through the kiln and chilling

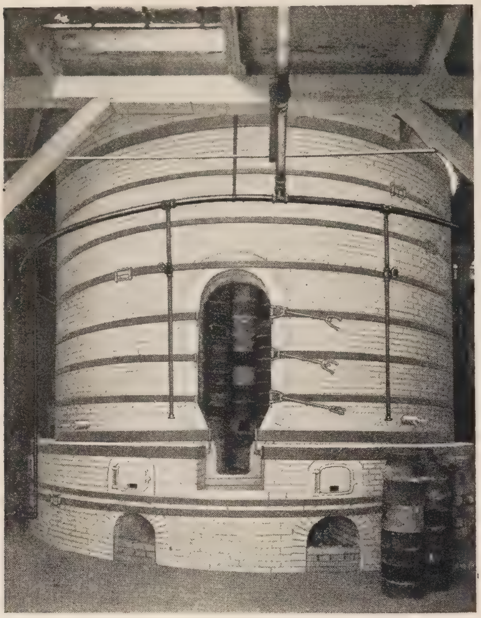


Fig. 12—Gas Fired Kiln Ready for Unloading.

the hot ware. Cooling progresses at a slow rate giving a perfectly annealed porcelain. The complete firing and cooling cycle requires one hundred and eighty to two hundred hours depending upon the kiln size. It is of the utmost importance that the firing of electrical porcelain be completed at the proper temperature. Underfiring results in porous material which slowly absorbs moisture in service, ultimately causing failure of the insulator. Overfiring produces warping of shells and a brittle porcelain with reduced resistance to mechanical and thermal shock. For these reasons a close check of the accuracy of pyrometers and cones is necessary.

During firing the fragile mixture of raw materials undergoes a complete transformation to a hard, ivory white porcelain, impervious to moisture and having the following characteristics:

Tensile strength in uniform sections 3,000 pounds per square inch.

Tensile strength in irregular sections 1,800 pounds per square inch.

Crushing strength for uniform sections over 50,000 pounds per square inch.

Minimum crushing strength for irregular sections 15,000 pounds per square inch.

Specific gravity 2.38.

Dielectric strength 250 kv. per inch for uniform sections up to 3/8 inch thick, and 170 kv. per inch for uniform sections from 3/8 to 1 inch thick.

Coefficient of expansion (per degree fahr.) .0000025.

Dielectric constant (approximate) 6.3.

Power factor 0.0065.

When the kiln cools to the proper temperature the porcelain pieces are removed and subjected to a critical inspection for improper firing, cracks, bloats, warping, pinholes in the glaze or defects in the sand-coated surfaces. (Fig. 12.)

Samples from each lot of insulators passing the kiln inspection are broken and fragments selected for the porosity test. This consists of an immersion in a solution of fuchsine dye and alcohol under a pressure of 4,000 pounds per square inch for twenty-four hours. The fragments are then removed, thoroughly dried, fractured, and examined for evidence of penetration of the dye. Penetration of the

dye indicates porous porcelain, and when this is discovered the representative batch of insulator parts is rejected.

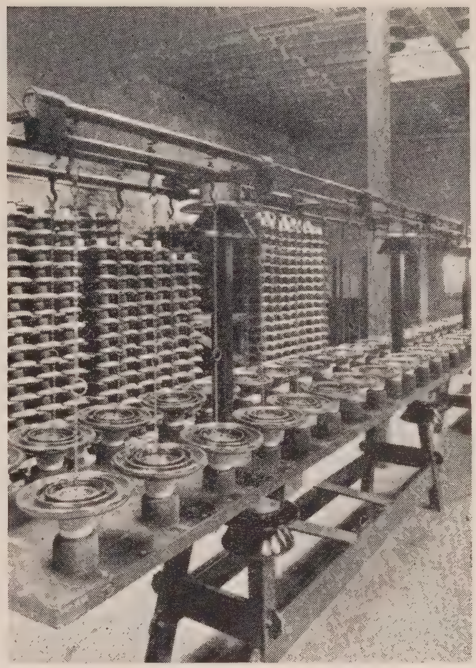


Fig. 13—Pan Test of Unassembled Shells.

The thermal test follows next, in which sample porcelain shells of each batch are clamped in frames and plunged into a bath of boiling water, where they remain for fifteen minutes. They are then removed and immediately plunged into a bath of cold water at 34 degrees fahr. for fifteen minutes. Two such immersions, one hot and one cold, constitute a thermal cycle. After five such cycles in succession the porcelain parts are tested electrically. If free from defects they are again subjected to five additional thermal cycles and tested electrically. Failure of any shells during the thermal test will result in rejection of that batch of insulators. The frames in which the shells are fastened are arranged to shield the interior of the shells from the water baths. This practice increases the severity of the test by retarding the temperature change on the interior of the shell where temperature change will be relatively slow in the assembled insulator.

All porcelain shells are next subjected to high frequency flashover at

Fig. 14—Routine Tension Test.

200 kilocycles per second for ten seconds. They are then placed on a rack holding from sixty to eighty pieces and given a vigorous flashover for five minutes at normal frequency 25 or 60 cycles. The combined capacity of the rack and shells creates a vicious flashover which destroys any parts which may be below average dielectric strength. This test is termed a pan test. These tests are usually witnessed by a customer's inspector, who personally examines and stamps each piece before releasing them to the assembly department.

In the assembly department all surfaces of the porcelain which will be in contact with cement or hardware are treated with asphalt paint. The surfaces of the hardware which are in contact with the cement or porcelain are treated in a similar manner. A twenty-four-hour drying period is then allowed for evaporation of the volatile constituents of the paint. The paint eliminates the possibility of thermal stress originating from the union of dissimilar materials subjected to rapidly changing temperatures. It also encourages an even distribution of mechanical load, preventing point contacts.

Malleable iron, forged steel and bronze are the chief metals used for insulator hardware. All hardware is manufactured to rigid specifications of the insulator manufacturer. Pieces picked at random from each lot of hardware are tested in his laboratory for quality and ultimate mechanical strength, while each piece accepted is given a critical visual inspection. Malleable iron and steel pieces are hot-dip galvanized before assembly to prevent oxidation.

Cork discs for the absorption of mechanical shock are fastened to each porcelain shell before it passes to the assembly table. Busbar pin and post type insulators are assembled with neat Portland cement in jigs which insure the proper height and accurate alignment of the porcelain and hardware. The insulators remain in these jigs for sufficient time to allow the initial set of the cement. They are then removed and subjected to a cement-curing operation. Suspension insulators are assembled with neat Portland cement in a press which gives perfect alignment of the cap and pin. After the initial cement set they are also subjected to a cement-curing operation.

Due to the high mechanical loads which insulators are required to carry, only the highest grade Portland cement available is used for assembly, each batch is tested for chemical composition, fineness of grind, setting qualities and mechanical strength at the laboratory of the manufacturer.

Tests for mechanical strength, soundness and freedom from excess lime and magnesia are again repeated in the laboratory of the insulator manufacturer before using a batch of cement. The cement and water are carefully weighed out and mixed in a mechanical mixer for insulator assembly. Only small quantities are mixed at a time in order that they will be quickly used to avoid the possibility of cement which has commenced to set being placed in an insulator joint.

After assembly the insulators are allowed to stand five days, they then

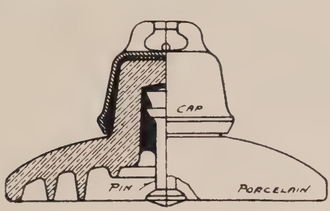


Fig. 15—Suspension Insulator.

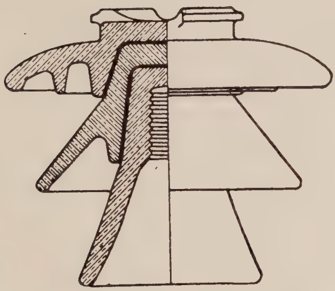


Fig. 16—Three-Piece Pin Type Insulator.

pass to the cleaning department where excess cement is removed and the porcelain and hardware are thoroughly cleaned. All exposed cement surfaces are next treated with a weatherproofing compound.

Suspension insulators are given a routine tension test seven days after cementing. A load of 5,000 pounds is placed on light duty insulators and a load of 10,000 pounds on heavy duty. Following the tension test the high frequency flashover and pan test is repeated on each assembled insulator, under observation of the customer's inspector, who again examines and stamps each insulator. Samples of each batch of insulators are also tested in the laboratory* to determine the wet and dry flashover values of the insulator, the load at which the insulator fails electrically, the load at which it pulls apart, the thermal performance of the insulator, its dielectric strength, and occasionally its lightning flashover value. Failure of any of the insulators to meet the specified requirements or failure of more than 8 per cent. of any batch on the final pan test will result in the rejection of that batch of insulators.

Post, pin type and busbar insulators are given similar treatment after assembly, with the exception of the routine tension test. Tubes for entrance and transformer bushings are tested similarly to parts for other insulators. They are then set up in jigs and placed in a heating cabinet in preparation for the gum filling operation. The temperature of the cabinet is raised to 280 degrees fahr. to drive all moisture from the tube surfaces and to allow the gum to seal each joint. Transformer bushings are treated to prevent oil leaks or creepage. All bushings are given a five-minute flashover at normal frequency before shipment.

This completes the manufacture of porcelain insulators as practised at the present time. In the modern insulator the customer receives a product which represents the best that modern applied science and technical research can yield in the selection of raw materials and control of manufacture, a product which is tested at potentials from three to ten times greater than those at which it is designed to operate, with mechanical strength many times beyond the most severe service requirements. For example a standard suspension insulator, which under normal conditions carries a tension

*A more detailed description of insulator testing technique may be obtained by consulting the A.I.E.E. Standards No. 41, March, 1930, covering Insulator Tests.

load of 4,000 pounds at an operating potential per unit of 15 kilovolts, has a dry flashover value of 85 kv., and a wet flashover value of 45 kv. The load at which the insulator will fail electrically is 15,000 pounds, that at which it will pull apart is 17,000 pounds. The dielectric strength of a single unit is more than 140 kv.

Wet process porcelain has many applications in the electrical industry, such as the insulation of transmission lines, station busbar and switching equipment, circuit breakers and transformers. It is also used for insulating mercury arc rectifiers, potheads, electric signs, radio transmitting equipment, for electrode entrances and spacers in electric steam generators, and for the production of cutout and fuse boxes. There are many other minor applications in the manufacture of electrical specialties.

An interesting application of wet process porcelain may be found in the insulation of a Vertical Radio Antenna. A single base insulator supports the entire weight of a 665 ft. mast weighing 62½ tons. This insulator is design tested to over 500 tons before installation. Guy insulators for this mast are design tested to 375,000 pounds tensile load.

There are two manufacturers of high voltage porcelain insulators in Canada. They not only supply all domestic requirements, but are in competition with the industry throughout the world. Canadian insulators carry power lines in Great Britain, Norway, Sweden, Italy, Spain, Africa, India, Australia, New Zealand, Mexico and many other smaller countries. Ninety per cent. of the insulators on the Scottish Grid and a high percentage of those on the English Grid were manufactured in Canada. Thus Canada occupies an enviable position in an industry which is a unique combination of one of the oldest arts known to mankind and the latest efforts of modern applied science.

The Discoveries of the New Planets—Uranus, Neptune and Pluto

OBSERVERS of early times could readily see five planets in the sky, in addition to the sun and moon. When the Copernican theory was accepted and the earth was recognized as being another planet, all of them revolving around the sun, these, together with our single moon, comprised the solar system. Saturn was then the outer guard, having the largest orbit, and marking off the boundary.

When Galileo searched the skies with his telescope in 1610, he found interesting features about these planets—Jupiter had four satellites. Sat-

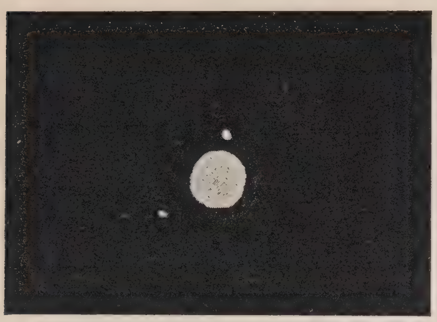


Fig. 1—The planet, Uranus, with two of its four known satellites. This planet appears as a disc with diameter about 3.6 seconds (of arc).—Yerkes Observatory.

urn had strange appendages which appeared and disappeared, Mars, Venus and Mercury showed phases somewhat like the moon. His discoveries enlarged the solar system in quantity of celestial bodies but Saturn was still the farthest known planet. Many astronomers, however, were curious as to the possible existence of other planets revolving in larger orbits.

Uranus

On March 13, 1781, Sir William Herschel was exploring the sky with a seven-foot telescope and came upon a small faint round object, sea green in color, which he took to be a new comet. Calculations respecting its orbit, however, showed it to be a planet revolving around the sun and farther away than Saturn. The discovery of this planet caused great excitement: several suitable names were suggested but it was finally called Uranus, after the mythical Father of Saturn.

Continued careful observations of Uranus have revealed that its diameter is just four times that of the earth and that it rotates on its axis in 10¾ hours, but this rotation is retrograde,—reversed in comparison with other planets. The distance from the sun is 19.2 times the earth's distance and the period of revolution is 84 years.

A peculiar feature of Uranus is that its axis lies almost in the plane of its orbit. For this reason, "northern" latitudes receive light from the sun continuously for about 40 years,—there will be no night during this time,—meanwhile "southern" latitudes do not see the sun—there is no daylight. When the planet is on the other side of its orbit, these conditions are reversed. Were the planet inhabited, business probably would be carried on in the northern hemisphere for 40 years or more and then there would be a tremendous migration to the southern hemisphere for an equal period, then back to the northern hemisphere again. This would be a most important factor in business activity on this planet. The temperatures, however, are very low and it is not likely that any life exists there.

Uranus has four satellites which revolve in the plane of the planet's equator, Fig. 1. Viewed from the earth, their orbits sometimes appear flat and at other times as practically perfect circles. Two were discovered by Herschel very soon after he first saw the planet; the other two were discovered by Lassell in 1851. Their names and revolution periods are as follows:—

Ariel, 2 days, 12½ hours.

Umbriel, 4 days, 3½ hours.

Titania, 8 days, 17 hours.

Oberon, 13 days, 11 hours.

Fig. 2—The planet, Neptune, and its solitary satellite. This planet is so faint that it is not visible to the unaided eye: through a telescope it appears as a disc with diameter about 2.5 seconds (of arc).—Yerkes Observatory.

NEPTUNE

Discovery is not altogether accidental; it very often comes as the reward of much study and careful observation. There are a few outstanding instances in the development of the sciences where study and mathematical calculations have revealed the necessity of the existence of energy in some new form, or of the presence of some material body, years before anyone made the actual discovery. Thus radio waves were predicted by Clerk Maxwell, as a deduction from his calculations, twenty years before Hertz was able to produce and receive these waves to show evidence of their existence and behavior.

The discovery of Neptune was another remarkable and similar instance. The movement of Uranus on its orbit had been watched for some time since Herschel discovered the planet but the observed variations in its motion were more than could be due to the attractions of Saturn and Jupiter. Two astronomers, Adams in England and LeVerrier in France, suspected that a planet beyond Uranus must be the cause of these perturbations. They, quite independently, computed the necessary position of such a planet and agreed very closely.

Adams was first to arrive at a result and carefully checked maps of the stars in that part of the sky where he determined that the planet was to be found. He gave his information to astronomers in England.

LeVerrier completed his calculations and sent the information to Galle at the Berlin Observatory where a new star map had just been made. Consideration of LeVerrier's conclusions and study of this map resulted in the discovery of the new planet on September 23, 1846, within half an hour after astronomers began looking for it and within one degree of the position which LeVerrier had given. This discovery was one of the most dramatic in the history of astronomy.

England and France suggested different names for the planet and as they could not agree, it was finally named Neptune, after the Chief Marine Deity of the Romans.

Neptune is nearly four times as large in diameter as the earth and rotates in about 15¾ hours. It presents a greenish disc, Fig. 2. The distance from the sun is about 30 times that of the earth so it receives only 1/900th of the light and heat that we receive. The period of revolution is 164.8 years.

In the same year in which Neptune was found, Lassell discovered one solitary satellite, Triton, which revolves

Fig. 3—The planet, Pluto, amongst the stars. This planet is very small and faint: it can not be seen except with the aid of a very powerful and efficient telescope. These photographs show the apparent backward motion of the planet over a period of one day: actually the earth is passing Pluto, whose real motion is to the left and very slow.—Yerkes Observatory.

around the planet with retrograde motion, the period being 5 days, 21 hours.

Pluto

The search for planets still further distant continued and history has repeated itself. Neptune when found was not quite as large as expected and its effect still did not fully account for the variations in Uranus' motion. In 1911, Professor Percival Lowell commenced a search for an Ultra-Neptunian planet, his calculations being based on observations of Uranus rather than of Neptune. In 1915, a year before he died, Lowell published the results of his elaborate calculations and predicted the direction of another new planet. The search was continued after his death until on January 21, 1930. C. W. Tombaugh, at the Lowell Observatory in Arizona, found the new planet by means of a photographic telescope, Fig. 3. After discovery, it was photographed frequently and a search of old records revealed its image on plates as far back as the year 1914.

As with other newly discovered planets, the question arose as to a name. For a time it was known merely as "X". Eventually, however, it was named, "Pluto",—the God of Darkness, using the symbol "PL",—the initials of Percival Lowell.

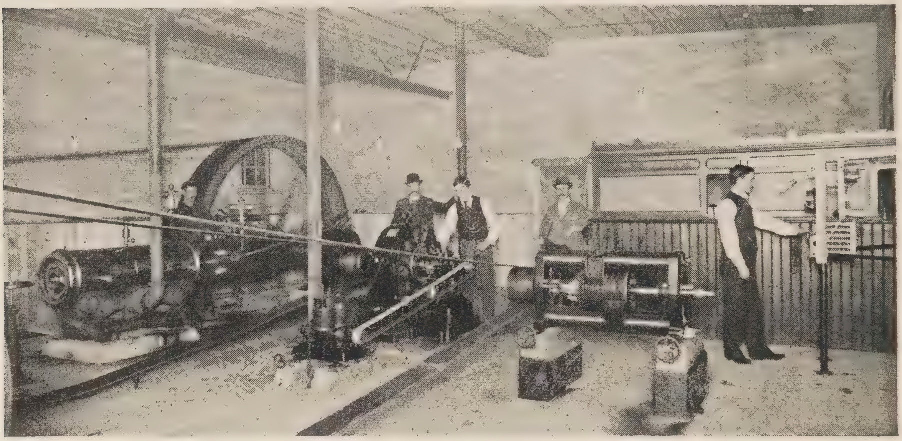
This planet is 39.5 times as far from the sun as the earth is and revolves around the sun in 247.7 years. Its diameter is estimated to be 3,700 miles. It is not known whether this planet rotates on its axis, however, and no satellite has yet been found.

Our Expanding Solar System

Our solar system has been increasing in size; the boundaries are now more than four times as wide and long as those known in Galileo's, Newton's or Kepler's days. The three new members were found within 150 years—

Uranus—In 1781.
Neptune—In 1846.
Pluto—In 1930.

These discoveries have been the rewards of careful observation, diligent study and accurate mathematical calculations. The opportunities came to those men who were prepared to recognize them: discoveries are not entirely accidental.—*F.K.D.*



Early Electric Lighting Plant in Aylmer

THE accompanying illustration is from a photograph of the electric lighting plant installed in Aylmer, Ontario, in 1897. The steam engine was a Wheelock condensing 100-horsepower. The generator was a Canadian General Electric machine rated at 60 kilowatts, 1,100 volts, 60 cycle, single-phase, the belt-driven exciter being an Edison bi-polar. The machine in the foreground was a d.c. arc lighting dynamo rated as 35 arc light, 2,000 c.p., per lamp. This plant supplied the Town of Aylmer until 1918, when it was superseded by Hydro power.

The men shown in the illustration, from left to right, are J. L. Millard, now Superintendent of the Aylmer Public Utilities Commission; D. C. Davis, now Secretary of the Aylmer Public Utilities Commission and Clerk of the Town of Aylmer; Mr. Gordon, formerly of the Canadian General Electric Company; P. E. Hart of the Canadian General Electric Company and later with Toronto Hydro-Electric System (deceased); and Mr. Lett, formerly of the Canadian General Electric Company.

During the first month in which Aylmer took Hydro power, March, 1918, the municipal peak load was 135 horsepower. Since that time there has been a steady growth in the load taken which in November, 1935, reached a peak load of 586 horsepower.

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Who Owns Hydro?

By Dr. Julian S. Boyd, Chairman, Simcoe Public Utilities Commission

(Presented at O.M.E.A. Summer Convention, Niagara Falls, Ont., June 30, 1937)

I HAVE been asked to give a paper on "Who Owns Hydro" but I am afraid it will only consist of a few remarks.

The question is of paramount importance to us, as representatives of the various contracting municipalities, and so far as I am able to judge and find out, the answer is very definite.

A booklet issued by the Hydro-Electric Power Commission in 1924, as a statement by Sir Adam Beck on the Commission's origin, administration and achievements gives this description of the set-up. I quote:

> "The generation and transmission of power on a wholesale scale is dealt with by a Commission which, although appointed by the Government of the Province, acts independently in the capacity of trustee for the partnership of municipalities.
>
> "Capital required for the plant for the generation and transmission of power is loaned by the Government upon receipt of formal requisition from the Commission. Contracts are entered into between the Commission and the municipalities under the terms of which the municipalities undertake to repay over a period of years the moneys thus loaned by the Government, with interest in full.
>
> "The basic conception of the whole municipally-owned, electrical undertaking as administered by the Hydro-Electric Power Commission of Ontario is a partnership of municipalities formed to obtain power at cost, each municipality paying its proportion of the cost for the service received. The Commission, acting as agent and trustee for the municipalities, exercises

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Vol. XXIV No. 7
JULY, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

both administrative and constructional functions."

I believe that one is justified in saying that the man who pays for an article owns it. I would refer to parts of Sections 26 and 56 of the Power Commission Act which read as follows:

> "**Sec. 26**—(1) The Commission may . . . acquire lands which the Commission may deem necessary for office, service or other buildings, and may erect thereon such buildings and works as the Commission may require for its purposes.
>
> "(2) All expenditures by the Commission for the purposes mentioned in subsection 1 shall be repayable to the Commission by the municipal corporations having contracts with the Commission, and shall be repaid by annual sums sufficient to form in forty years a sinking fund for the repayment of the cost thereof."
>
> "**Sec. 56** . . . the price payable for power or energy by any municipal corporation shall be the cost to the Commission as determined by it, of supplying and delivering power or energy to the corporation, including the corporation's proportion, as adjusted by the Commission, of,—
>
> "(c) an annual sum sufficient to form in forty years with interest at four per centum per annum, a sinking fund for the repayment of the advances made by the Province of Ontario under this Act for the payment of the cost of the works and also for the repayment of any other indebtedness incurred or assumed by the Commission in respect of the cost of the works."

Some three weeks ago, in the course of gathering ideas, I had a short interview with Mr. T. Stewart Lyon, Chairman of the H.E.P.C. His answer to our question of to-day was approximately, "Why, Doctor, there is no question as to the ownership, it is in the contracting municipalities."

In short, the entire Hydro hook-up of Ontario, general and local, is owned by the contracting municipalities. Of course, there never was any ambiguity about their title to their own local works, but their co-operative and partnership ownership extends to all the provincial works.

The Provincial Government enters the picture as the banker who supplied

the funds, and who has at least one member on the Commission to guard its interests. The H.E.P.C. acts as a trustee to administer the parts which link the municipal units, and to co-ordinate the whole.

Some figures might be interesting: Provincial advances for capital expenditures have amounted to $207,000,000. By April 1, 1937, this had been reduced to $151,572,000.

There will be no more advances by the Government for capital expenditures. The Commission will do any further borrowing in its own name and for itself, with Ontario simply "backing the note". It has already issued new, or assumed certain outstanding issues to the amount of $114,199,000. By the time the old advances have been wiped out by the sinking-fund payments, which are provided by the contracting municipalities, the whole structure will be standing on its own feet.

Gentlemen, the contracting municipalities own Hydro. Our paid-up equity in the great enterprise, outside of our local individual distributing plants is $39,088,953, and the total assets of the H.E.P.C. amount to $341,623,452, or about 11.44 per cent.

The World's Largest Telescopes and Where They are Located

REFLECTORS

200-inch: (to be finished about 1938); to be located at the new Astrophysical Observatory of the California Institute of Technology, Mt. Palomar, Calif.

100-inch: (known as the Hooker telescope); Mt. Wilson Observatory of the Carnegie Institution, near Pasadena, Calif.

85-inch: University of Michigan Observatory, Ann Arbor, Mich.

82-inch: McDonald Observatory of the University of Texas, Mt. Locke, Texas.

74-inch: David Dunlap Observatory, University of Toronto, Toronto, Canada.

72-inch: Dominion Astrophysical Observatory, Victoria, B.C.

69-inch: Perkins Observatory of the Ohio Wesleyan University, Delaware, Ohio.

61-inch: Harvard Observatory, Oak Ridge, Cambridge, Mass.

60-inch: Mt. Wilson Observatory, Pasadena, Calif.

60-inch: Harvard Observatory, Southern station (Harvard Kopje), near Bloemfontein, South Africa.

60-inch: National Observatory of the Argentine Republic, Cordoba, Argentina.

48½-inch: Berlin-Babelsburg Observatory, Berlin, Germany.

48-inch: Melbourne Observatory, Melbourne, Australia.

40-inch: (Ritchey-Chrétien) U.S. Naval Observatory, Washington, D.C.

40-inch: Lowell Observatory, Flagstaff, Ariz.

40-inch: Stockholm Observatory, Stockholm, Sweden.

40-inch: Simeis Observatory (a branch of Pulkowo Observatory), Crimea, U.S.S.R.

40-inch: Yerkes Observatory of the University of Chicago, Williams Bay, Wis.

39½-inch: Hamburg University Observatory, Bergedorf, Germany.

39¼-inch: Geneva Observatory, Geneva, Switzerland.

39¼-inch: Meudon Observatory (a branch of the Paris Observatory), Meudon, France.

37½-inch: University of Michigan, Ann Arbor, Mich.

36-inch: (known as Crossley Reflector) Lick Observatory, Mt. Hamilton, Calif.

36-inch: Steward Observatory of the University of Arizona, Tucson, Ariz.

36-inch: Observatory of the Catholic University of Chile, Santiago, Chile (formerly the Chile Station of Lick Observatory).

36-inch: Royal Observatory, Edinburgh, Scotland.

36-inch: Royal Observatory, Greenwich, England.

36-inch: Lick Observatory of the University of California, Mt. Hamilton, Calif.

32½-inch: Meudon Observatory (a branch of the Paris Observatory), Meudon, France.

31½-inch: Astrophysical Observatory, Potsdam, Germany.

30-inch: Pulkowo Observatory, near Leningrad, U.S.S.R.

30-inch: Allegheny Observatory of the University of Pittsburgh, Pittsburgh, Pa.

27-inch: University of Michigan, Southern station at Bloemfontein, South Africa.

27-inch: University Observatory, Vienna, Austria.

26½-inch: Union Observatory, Johannesburg, South Africa.

26-inch: U.S. Naval Observatory, Washington, D.C.

26-inch: Leander McCormick Observatory of the University of Virginia, Charlottesville, Va.

26-inch: Yale University Observatory, Southern station at Johannesburg, South Africa.

26-inch: Royal Observatory, Greenwich, England.

24-inch: Harvard Observatory, Southern station (Harvard Kopje) near Bloemfontein, South Africa.

24-inch: Royal Observatory, Cape of Good Hope, South Africa.

24-inch: Radcliffe Observatory, Oxford, England.

24-inch: Stockholm Observatory, Stockholm, Sweden.

—*G. Edward Pendray in "Men, Mirrors and Stars"*.

Meter Symposium

(Discussion at Niagara Falls Convention of the Association of Municipal Electrical Utilities, June 29, 1937.)

Are Meter Associations Justified?

By P. B. Yates, Manager, Public Utilities Commission, St. Catharines

ELECTRIC meters are the yard-stick by which a municipal electrical commission measures electrical service given to its consumers.

If an electric meter were as simple a guage or measure as a yard-stick, the equitable determination of service given to each consumer would be a simple proposition, but electric meters have many complications which do not arise when a merchant is measuring a few yards of cloth or a few pounds of merchandise to a purchaser. Electric meters are subject to variation due to factors some of which are most elusive and which complicate the equitable determination of cost between the different consumers supplied by an electrical distribution system.

Under present regulations, all electric meters must be checked for accuracy by a Government Inspector before being placed in service and when a meter is found to be correct within the percentage of 3 per cent. plus or minus, the meter is sealed by the Government Inspector and authorized for use. After being so sealed, it is subject to variation due to jolts and jars during transportation from the meter room to the completed installation. Its accuracy is also subject to variation due to the percentage of its full rated load which it is called upon to measure. Its accuracy is subject to variations in voltage of the supply circuit. Its accuracy is subject to variations in the power factor of the circuit on which it is used. Its accuracy is subject to variations in temperature. And fundamentally its accuracy is subject to variations in friction within the meter itself, a variation in the efficiency of the meter due to defective jewels, dry bearings, etc., which may arise to disturb the accuracy of the meter during the period of service of five or six years before the meter must be again returned for re-calibration and re-inspection.

Another way in which the accuracy of the distribution of service costs between the different consumers may be destroyed is through a possible diversion of current. In discussions of this subject, the phrase "diversion of current" is used as a polite synonym of the much franker expression "stealing juice". While this is not a subject with which a meter laboratory is concerned, it is a most important subject for the consideration of the manager or superintendent of a system and the service crew installing

the meters. Connected with this last subject is the question of location of a meter for the greatest convenience of the meter reader. A meter located in a consumer's attic where not only entrance to the house must be secured but where two flights of steps must be climbed takes more time to read and therefore costs more to read than a meter located, let us say, in a meter box on the outside of the house. This subject therefore originates further items for discussion.

A municipal system with a large number of consumers can afford to employ technically educated and trained executive engineers to have charge of their meter work. The next class of municipal systems with a few thousand meters in each municipality has at most two or three technically trained men among all of their employees. Then there is another class where the superintendent of the system has no technical education or training but has only practical experience as his guide. As a result there are many meters installed to measure the consumption of power by consumers on municipal systems throughout the Province of Ontario where the original accuracy of the meter in the laboratory where the meter is inspected by the Dominion Government Inspector, is changed more or less, and often absolutely destroyed before the end of the test period. The reports of the Dominion Government Inspectors who have concerned themselves with the accuracy of the meters when brought in for retest confirms this statement.

At the present time, the municipalities on the 25 cycle system of the Hydro Electric Power Commission of Ontario are threatened with regulations much more severe than the Department proposes to retain for 60 cycle meters. This variation in regulations is not due to the greater inherent accuracy of the 60 cycle meter but is due to the fact that the greater percentage of 60 cycle meters across Canada are under the care of specialists educated and trained, employed by large power systems who are able to pay salaries sufficient to secure such trained men. If the 25 cycle municipal systems of the Province of Ontario do not improve the average accuracy of their metering, the Dominion Government threatens to introduce regulations concerning 25 cycle meters which will increase the costs of retest of meters for all 25 cycle systems. The Toronto Hydro Electric System is at the present time vitally interested in improving the metering on the small village systems operating at 25 cycle throughout the Province. The systems of Toronto, Hamilton and Windsor with their hundreds of thousands of meters may be penalized due to bad meter practice in smaller systems. These large municipal systems therefore are not justified in sitting back without being concerned in the general improvement of meter practice on the Niagara System—they should be most interested in the general improvement of meter practice by the smaller units of this great co-operative movement.

Discussing this matter with the

superintendents of the different systems we find that the attitude of the local commissions is subject to great variation. Most commissions undoubtedly if called to task for insufficient or inadequate equipment for properly recalibrating and testing meters, will answer that if their superintendent requires equipment he should have asked for it and it would have been supplied to him. A superintendent or manager of a small system who must handle all phases of the business from voltage regulation to public relations cannot specialize in each department. The equipment needed in such a meter department is not standardized any more than the knowledge of the superintendent is standardized.

Another commission will reply that it cannot afford better and possibly more expensive equipment, and no doubt in many cases this is true, and yet to correctly and equitably furnish to each consumer "service at cost" it may be necessary to force such a commission to correct its methods.

A man in charge of meter retest and maintenance in the great middle class of municipal systems in relation to size, is not a technical man, his knowledge has been gained through practical experience and his decisions often have been reached through incorrect premises. Many of such men are unable through lack of fundamental knowledge to gather any information of value to them by the study of books and reports which they may be able to obtain even if such books and reports are brought to their notice. Practical experience perpetuates many fundamental errors and yet the decisions of these meter men are based only on practical experience.

We are faced with a situation which calls for immediate attention if our costs of meter maintenance are not to be greatly increased by Government regulations. How are we going to handle this? We believe that if we can secure at meetings of a District Meter Association the attendance of the men concerned with the metering of power, we are going to greatly improve the existing situation.

If all of the meters in use by one municipal system were 3 per cent. high or 3 per cent. low in their registration, there would be no unfairness in the accounts sent to the different consumers of such a system. The conditions as found however are that some meters when brought in for recalibration are found to be much more than 3 per cent. high and some are found which are much more than 3 per cent. low. As between two consumers, the one that the meter is registering high and the other with a meter registering low, there may be considerable difference which is not fair to those consumers and this is the view of the situation taken by the Department of Trade and Commerce in charge of electricity inspection service.

Taking as an example a relatively small municipal system with total earnings of $165,000.00 and a meter maintenance of $1,150.00, giving us a ratio of cost of meter maintenance to total earnings of 6/10 or 7/10 of 1 per cent., such a consumer with

3800 meters in service is not employing a full time meter man. If these meters are registering on the average over all of the meters 1 per cent. slow, the accounts sent out would be for 99 per cent. of the kilowatt-hours actually used. With the Ontario system of rates we cannot say that an increase of 1 per cent. in the kw-hr. billed would increase the revenue 1 per cent., but we can be sure that it would increase the revenue on the average 1/2 of 1 per cent., and 1/2 of 1 per cent. of $165,000.00 would be $825.00.

We believe that this saving under the minimum conditions expressed above will warrant a considerable increase in the annual expenditures made for meter maintenance, and the relatively small cost of such a municipality sending its meter men to district Meter Association meetings four times a year for education and the exchange of experiences is more than warranted.

The Niagara District Electric Meter Association covering the territory from the Niagara river west to and including Hamilton has now been in existence for one year. The members of the Association are the commissions or companies who desire to join, with an annual fee of $1.00 per 1,000 meters in service with a maximum of five dollars and a minimum of one dollar per year. We have had four meetings during the year attended by representatives of a number of the municipal systems, the number attending having gradually grown until the last meeting when we had 15 municipalities represented. We started with meetings held during the daytime but on the advice of some of the commissioners interested, these were changed to dinner meetings called for 6.30 p.m., and we find that the change has increased the attendance and has overcome difficulties which existed when we were holding meetings during working hours.

As far as possible the discussions and papers are confined to practical subjects without using technical terms and formulae which might prove difficult for some of those in attendance. If technical questions become involved, these subjects are discussed by those meter men in attendance who have had technical training assisted by the representatives, mainly members of the engineering staff of the meter manufacturing companies. While on this subject we must express to the meter manufacturing companies our deep obligation to them for their great assistance to our association by authorizing the attendance of members of their engineering staff. The guidance of these engineers in the discussions and decisions of our association are very valuable to all of the meter men in attendance.

Another point we wish emphasized is that the municipal meter men attend these meetings on their own time and at their own expense.

A meter man from a municipal system who has to handle all phases of the work of the municipal system, at one of the meetings of the Niagara District Association submitted for consideration his difficulty regarding the 50 per cent. power fac-

tor test. Information was given to him so that he may modify his existing equipment at a very small additional cost so that the requirements of the new regulations might be met.

Any major point brought out for discussion at one district meeting of the Meter Association is passed on from one district to the other. This makes for some definite action by united effort and it is possible things may be accomplished which otherwise could not have been done.

As the manager of one of the great middle class (in point of size) municipal systems and as Chairman of the Niagara District Electric Meter Association, I cannot too strongly emphasize the possible financial return of any money invested by a municipal electrical system in securing the attendance of their representatives at these practical meetings. Labour questions are not discussed for it is not a labour union that is being promoted. Our one endeavour is to improve the accuracy of the metering of our electrical consumers and for our own protection help to improve the meter departments of our neighbouring municipalities co-operating in the Hydro Electric System of the Province of Ontario.

* * * *

A Few Suggestions on Meter Maintenance Methods

By W. A. Armour, Meter Foreman, Hydro Division, The Windsor Utilities Commission

WE have in our area a Meter Association which was formed in Chatham some two years ago and some real progress has been made. The advantage in this Association is that it covers a comparatively small area; no one has far to travel and one day will generally be all the time necessary. Meetings are held about twice a year and this gives the opportunity to exchange ideas and compare results, as it is obvious that all systems are interested in the same problems and what appears to be a problem to one turns out to be every-day routine with another, so that all will benefit regardless of size or importance.

So I am outlining a few essentials of meter practice. The general procedure in adding to or starting a meter department, is to select someone in the present staff and place him in charge of the meter department. This is done in nearly every case and it is O.K., providing he has the support of those over him and he will probably develop into a good man, if he has this support, which includes two necessary items of equipment and tools. Furthermore he is in direct contact with the customer in a good many cases and

if he is a good meterman, he will also be a good representative of the company, which is desirable at any cost. He must also realize that the good tools and parts, if they are available, are just a start as his work does not consist of his best efforts for a year or five years, but it is a perpetual job to keep the meters under supervision constantly in the best condition he can possibly strive for, and if he finds some other department who by its experience has found a way to improve the work involved, he should take advantage of it.

The equipment should consist of proper test boards, test meters, loading devices, and proper tools, and it is impossible to do justice to the work without all of these. Several utilities in our district, within the last year or two, have built or purchased good test tables and much activity along this line has been apparent.

The trend in test tables seems to be a five or ten meter table with facilities for single phase or polyphase meter test and in most cases this will do nicely with the proper supply, generally 3 phase, 115 volts and suitable potential and loading transformers. This table will do what is required by the Inspection Department at this time.

Mention of the Meter Association is made because some felt it was a union of metermen for financial gain. This is not the case as the gain is for the utility through better meter practice.

Some metermen prefer to build their own test tables and devices. One advantage here is if he builds it, he will know what he can do with it and the inspector in the district should be consulted as to this, as he must use it as well as the Department and in this way something standard along this line will result. We have found the inspectors in our district more than willing to do their share.

In large meter shops it is possible to have a large variety of types and sizes of different makes. This requires larger stock of repair parts which are very necessary. Also frequency of tests as applied to one make or size will not apply to another make.

In the meter department of the Windsor System, records of the accuracy of meters removed from service have been kept for a number of years and we have found this very valuable as it will give direct information as to work done on the meter; also whether this work was justified or not. We have made charts of this performance but time will not permit showing of them here.

These charts have shown meters should be serviced and re-tested according to their own ability and the load involved, rather than to use the ruling of the Government seal period of 5 or 6 years.

I would like to draw your attention to the recommendations of the Meter Committee of the N.E.L.A. published about 25 years ago in the Hand Book—That all a.c. meters up to and including 25 amperes

be retested at least once in 24 months. Also the Meter Committee of this same N.E.L.A. in an edition of the Hand Book published some 10 or 12 years ago, extended this time on the same size of meters to 48 months. This would tend to show two things: First—better watt-hour meters were being built. Second—better methods of maintenance on older types of meters. We all have a certain percentage of these old types on our system.

New meters available in Canada today are second to none, and this is as it should be because the manufacturer has devoted a good deal of time and money on improvements on watt-hour meters for about 50 years.

This of course will not apply to other types such as maximum demand meters. From an age standpoint, they are comparatively new whether they are of the thermal or block interval type. These meters with reasonable care and more frequent test will give a good account of themselves. On our system we have been instructed to re-test this type of meter once in two years and records have proved the value of this decision. Several other utilities in the western part of the province are doing the same and getting good results.

This type of meter is generally used on commercial type of loads and the revenue involved will permit more frequent test, and it will be found both justifiable and profitable. A recent survey of service conditions in the Dominion has brought out the fact that 16.7 per cent. of the total number of customers produced 67 per cent. of the total central station revenue.

If the tendency is to leave them 6 years by virtue of the fact that the Government inspection period is 6 years, the fault is not all with the meter, as the ruling of 6 years made over 40 years ago, will not apply in every case, and some period had to be decided on when this law was passed.

In renewal of parts, one meter department will be found to use larger quantities of parts on a given number of meters than another department. The one explanation of this is the method of examination. It is almost impossible to detect a worn jewel or pivot without a microscope. Some use a needle point to examine the jewel, but how do you apply a needle point to a pivot or ball? A good microscope of not too great magnification is the proper method, and the diameters used are from 20 to 40 with recommendations of 30.

The friction of worn or flattened jewels or pivots may be overcome by adjustment of full load on the meters but the results are only temporary for if the meter is slow due to this cause, the cost of a new jewel and pivot is only a fraction of the possible loss. During a service period of 5 or 6 years, registers, too, need more than ordinary attention.

Load building and good meter practise go hand in hand and it appears some of the good efforts of load building can be cancelled out by the bad effects of poor meter practice.

Records prove that meters will slow up over long service periods due to several causes, and it is by these meters that service is measured and paid for, and if the measuring medium is in doubt, it should be corrected and more equitable billing will result.

We use the same meters for a good many years. No one seems sure of the life interval. Some say 16 years, some 20 years, yet we find meters in service about double this period and whether it is profitable to leave them in service will obviously depend on the maintenance applied to them.

The fact that our rates are comparatively low would tend to minimize this loss, but examination will show that while our rates are low, we also have comparatively high consumption, which would be reason enough for more accurate meters, and the Meter Department itself with its equipment, methods, and personnel, is a fair example of the efficiency of the meters they service.

In the modern meter the reduced full load speed will tend to reduce wear and increase life of the various moving parts, and some saving will be apparent, but we each have our share of old ones, and like the old car, the fact it runs is not good enough, it's how well it runs.

Our Government inspection service is better than that in force in some States as we have the same men to deal with year after year. They have a rather difficult job as they get a great variety of test equipment to work with and not much co-operation in a good many cases. They have had to compel some to submit meters for reseal, and in doing this, conferred a favour on that company by doing so.

SUMMARY

I have tried to point out some of the facts of good meter practice and this does not indicate we need more meter-men, rather a better understanding of the work and conditions involved will do more to correct undesirable features, and while dollars appear to be saved by deferred meter maintenance, actually many times this amount is lost.

The meter should be credited for what it is, and not looked upon as just another necessary piece of operating equipment. Some manufacturers have been very frank about the inability of the meters they made years ago. Others just point out the outstanding features of the present meter they build, which will add up to the same thing.

The large meter departments may feel that they are doing just the right thing from a maintenance standpoint and that they have reached a stage of perfection far superior to the smaller departments. This is true. Nevertheless they are in a position to be of assistance to the smaller ones and if they give this assistance a general increase in good methods will result which will be of value to all the systems as a whole.

Considerable improvement in servicing meters in the last few years

has been evident in some meter shops. This is possibly due to the interval when a marked reduction in integrated kilowatt-hours was evident everywhere. This gave some departments time to analyze the active meters on the system to find out if they were doing a good job of metering. If this is the case, and it is reasonable to assume that it is, the good effects will last.

The managers of the utilities in the western end of the Province, are to be complimented on the view they have taken in regard to the Association of Metermen and the support they have supplied has been of real value.

* * * *

Meter Associations Are Necessary

By W. R. Catton, Manager, Hydro Department, Public Utilities Commission, Brantford

THE average meter man to-day no doubt received his initiation into the meter business by first reading meters, then by gradual steps to the calibrater's position. His fund of knowledge consists of practical experience and some theory. It is his job to so calibrate a meter that it will be perfect when sealed and it should stay nearly perfect for five years.

The meters are the product of highly trained technical men who do nothing but think meters and are always on the alert to make a change to improve their product, consequently, there is a difference in the design of any one make over a period of years. Each type of all the various manufacturers has its own individual calibrating characteristics.

Much more could be said about the utility meter man and the meter designer and his product but to make my observations as brief as possible and to talk in support of the Meter Men's Association I would ask this question —Does it sound reasonable that we should rely on a non-technical meter man to do a good job if he has not had long association with his job or assisted a man who does know the work?

I need not mention that all the revenue collected is based on what the meter reads and if the Meter Men's Association will broaden the knowledge and vision of our men that knowledge will be reflected in more accurate meter maintenance, thereby giving the utility the maximum return from its meters, and from my experience with the Association I know that the cost to attend is so small that one small error on a demand meter would cover the cost of the Association expense many times over.

Healthy Comfort

By James Govan, M.R.A.I.C., of Govan, Ferguson & Lindsay, Architects, Toronto

(Presented to the Ontario Municipal Electric Association and the Association of Municipal Electrical Utilities at Niagara Falls, June 30, 1937.)

James Govan, of the firm of Govan, Ferguson & Lindsay, is one of the prominent hospital architects in Canada. He was the architect for the large new addition to the Western Hospital in Toronto, as well as for many other important hospital buildings in Canada. He has made a study of the effect of air-conditioning on health, and was chosen to lead discussions on papers before the American Hospital Association. Mr. Govan is responsible for two new air-conditioned operating rooms in the Hospital for Sick Children in Toronto, and also for the ultra violet ray installation in one of these rooms, which is used to kill bacteria in the air. There are only one or two such installations in the world, and research is being carried on in connection with these, which will soon provide interesting and valuable data on air sterilization. —EDITOR.

THE title of this paper at once suggests the question—is it possible to enjoy unhealthy comfort?

My answer to that is that our ordinary Canadian heating methods provide that very condition—unhealthy comfort, and furthermore, as we go in for extensive summer cooling by means of present day air conditioning, we are almost certain to make matters worse, so far as the general health of our people is concerned.

Feeling as I do, I welcome the opportunity of submitting some suggestions as to how the objections to our present methods of heating and cooling may be overcome and how this Association might sponsor further research study that would be of tremendous value in promoting the development of healthier living environment and the economic welfare of our people.

Human comfort is governed by the rate at which body cooling takes place. Our problem in Canada is not one of providing heat to the body, but one of regulating the rate of dissipating the heat which is generated in the body from the oxidation of food stuffs.

Broadly speaking, our Canadian methods of winter heating are based on raising the temperature of the air inside our buildings up to and maintaining it at a high enough level to take care of the heat lost by transmission through walls, roofs, and openings, and of the ventilation requirements.

More recently we note the intensive drive to promote cooling in summer by lowering the temperature of the air inside buildings.

We are all agreed that engineers on this continent have developed these methods to a remarkably high point of efficiency in creating comfortable conditions for indoor living, work and play.

Whether comfort so obtained is enjoyed at a sacrifice of health, is a question that has not received the

attention it deserves. Some of the most eminent physiologists have expressed grave doubts as to the wisdom of engineering and architectural efforts directed along these popular American and Canadian lines.

Among these "doubting Thomases" stands Prof. C. A. Mills, Director of Experimental Medicine at Cincinnati University. Prof. Huntington of Yale has pretty definitely shown that the energy level—and therefore the economic status—of human beings all over the world, past and present, were and are largely dependent on climatic influence. [1]

Prof. Mills' work corroborates Huntington's findings and he has extended the investigation to note the climatic urge on the incidence of various diseases and the resistance of people to them under varying climatic conditions.

His papers and addresses are in demand, not only by medical journals and societies, but also by many other scientific and professional associations.

Last year he was appointed Chairman of a research committee of the American Society of Heating and Ventilating Engineers to study "Climate and Its Relation to Air Conditioning Fundamentals" of which Committee I also have the honour of being a member.

He bases his conclusions on observations of patients in clinics and hospitals under controlled conditions and the use of enormous masses of statistics on weather and disease from all over the world.

In support of my contention that our generally approved Canadian and American methods of heating and cooling may provide comfort and yet not be health promoting, medical evidence is necessary, so being an inexpert layman, I have attempted to summarize Prof. Mills' position by quoting from his writings as follows:

Quotation from Mills' "Living With The Weather" and Other Papers

"Facts now at our command indicate that for the mass of people the energy level of the body, which may be thought of as very much like the available horsepower of a motor, is dependent on the demands made by the climatic environment upon the heat-producing mechanism of the body. Now both energy and heat come from combustion processes in the body—the burning of food stuffs—and when heat production must be curtailed because of external warmth, then we also find that the available energy declines. This is particularly true when the individual lives for months or years in moist heat.

"In the tropics and the Orient, where such depressive heat occurs for prolonged periods each year, bodily energy is distinctly lower than in cooler climates.

"Peoples of the cooler regions offer quite a contrast to this picture of the Orient and the South. For comfort in the northern cold they develop a high rate of combustion, and as their heat production rises, so does their energy and capacity for activity.

"In addition to these effects of temperature level in different latitudes, north and south, there is also another even more important weather factor

(1) Huntington—"Civilization and Climate".

affecting man's energy. It has been found that frequent change from warm to cold, every day or every few days, is most stimulating of all, and that in the warm regions having frequent storm changes, people are energetic and almost as active as Northerners. In Western Texas and Oklahoma, for instance, where the effects of southern heat are counterbalanced by the storms that sweep down over the plains from the polar region, we find people living on a distinctly higher energy level than do those residing in Alabama and Georgia.

"Most stimulating for man is a cool climate, with wide and frequent storm changes in temperature. Under such conditions greatest bodily vigor develops—a vigor that drives people into action.

"Nowhere in civilized countries is there an area that is equal, in this respect, to the central trough of North America. Cold polar storms sweep from the Mackenzie Valley in Canada down the western plains, sometimes as far as the Gulf of Mexico. They may turn eastward anywhere between the Canadian border and the Gulf of Mexico, then returning northeastward to leave over the Gulf of St. Lawrence. Week after week, year after year, they come, less frequently in summer and veering eastward further to the north. But in the northern states (and of course in Canada) people must be continually adjusting to these wide changes, and it is largely this that gives them their vigor and pep. Here man must be ready at all times to meet chilly or cold weather, yet when his heat needs are lessened, he is driven to rid himself of his extra heat as energy output. Under such a climate is found the greatest bodily vigour that exists anywhere.

"This high bodily vigor is matched by a similar dynamic state in the nervous system, and leads to the restlessness so prevalent in the Northern States.

"The ambitious urge, induced by this climatic drive, leads people only too often beyond their bodily or mental capacity. Activity of all kinds goes on too intensely. It is in these most stimulating regions that bodily and mental breakdown are increasing most rapidly.

"Many people feel that it is the pace of the life about them that is at fault, that it is modern civilization which has developed too great an acceleration. Rather it would seem that the restless vigor of individuals here, multiplied by the millions of population, is responsible for the speed of life round about. Each individual is affected just as he takes part in accelerating the pace. Nor does it seem that he could slow down even if he so desired. The climatic urging, affecting as it does the basic factors of our existence, would appear to be an inexorable force beyond the power of individual control. This is not really true, however, for we can control our indoor weather, and have at our command a means of partial relief from too excessive stimulation.

"The human body seems to have only a limited capacity to respond to climatic urging, and where the drive is most intense, we see most marked evidences of exhaustion.

"What can we do about all this? The driving force of the weather can be lessened by more intelligent control of indoor environment. Air con-

ditioning offers a means of such control, but we need more specific information on weather effects and just what environmental conditions are best for man in the long run. We must know what level of stimulation is best, not for a year or a generation, but for a thousand years. Almost certainly our American weather needs much toning down, especially in its effects on the nervous system.

"Medical scientists have found that many diseases do not affect man the same way in all regions,—that they are severe in one climate and mild in another. This applies especially to the parasitic diseases such as malaria and hookworm, as well as yellow fever, plague, etc., where the organism either needs special temperature conditions to flourish, or else is carried by an intermediate host that lives only in certain climates. But man himself also differs in his reaction to disease, depending on the climate under which he lives. The more stimulated he is by his environment and the higher his energy level of existence, the more resistant he is to infection.

"Were the people of the Old South, or of any tropical region, to be suddenly afflicted with the storm changes of a normal northern winter, the respiratory disease death rate would be appalling. Such a state existed for practical purposes when, during the world war, large numbers of troops and labourers went from Africa and India to Central Europe and from our southern States northward into the cold, stormy winters.

"In the stormy North, however, payment is made in other ways for the high energy level that gives such a great resistance to infection. The strain of the active life and rapid combustion brings on in severe form the diseases of exhaustion and breakdown of body and mind.

"Diabetes, where there is a breakdown in the sugar combustion that supplies us with most of our heat and energy, is a particularly troublesome disease in the cooler, stormy regions of the earth.

"Toxic goiter is also a disease most severe and frequent where the climatic drive is most intense. Pernicious anemia, a disease of exhaustion in the blood-forming organs shows this same relationship.

"This stress of existence shows also in the hardening of arteries and heart failure that is so much prevalent in cool, stormy regions.

"One finds evidences of intestinal putrefaction only infrequently in the non-stormy regions of the earth. Only where storm changes in temperature and pressure come frequently do we find the "Sewer" tending to become foul and poison the system. No satisfactory explanation has yet been found for this fact, but its validity holds just the same. It does constitute a major problem in personal health and hygiene here in America and in west central Europe.

"Most important of all, however, is the high rate of nervous breakdown and mental disease where the storms are most severe and the climatic stress greatest.

"In our storm region of central north America, it would seem that the constant succession of weather changes is in large measure responsible for the nervous instability and

lack of poise so characteristic of the people. The continuous mental turmoil, with exuberance and depression in frequent alternation, robs us of our calm and may explain a growing, nervous exhaustion in the population.

"Summed up, Arteriosclerosis, heart failure, diabetes, cancer, pernicious anemia and a host of other diseases of breakdown in bodily function are yearly becoming more alarming to the medical profession by their continued increase in importance as causes of death. Mental breakdown, functional insanity and suicide are likewise showing the increased mental stress that is resulting from the greater drive of the cooler regions.

"Americans (and Canadians) pride themselves on their accomplishments in athletics, in business expansion, and in having so quickly developed the American wilderness into one of the foremost parts of the earth. They feel that they have far surpassed in many ways their ancestral stocks in the Old World. But hasn't it been largely the climatic urging that has driven them to these accomplishments? And is it not now this same urging that is driving them on toward the brink of bodily and mental breakdown? It is time we gave thought to the trend of our existence, and attempted to achieve some degree of control over our racial destiny.

"With the general level of vigor and vitality in a population mass thus seen to be determined largely by the ease or difficulty encountered in dissipating from the body the heat generated by every action that goes on inside, how can it be that weather effects on the American people are responsible for their pep and vigor when they live in an indoor sub-tropical climate most of the time? With our houses, offices and public buildings kept at 70-75 deg. fahr. all winter, and with only an hour or two a day spent outdoors, how can the weather affect us as much? What does it matter if a 50-80 deg. fahr. drop in temperature sweeps down out of the north-west every week or so, if we are snug and warm inside? Why blame the storms of winter if they seldom reach our bodies? One important point, however, is overlooked. Storm changes come only every four to six days in winter, but we artificially produce just as marked a temperature change every night. We live during our waking hours at 70 deg. fahr., then at night throw open our windows, turn off the heat and breathe cold night air while we sleep. Probably the average winter drop in temperature each night in northern bedrooms would be found to be in the neighborhood of 50 deg. fahr. True enough our body surface is not often chilled by this air, but we do breathe it into our lungs where chilling takes place and body combustion is stimulated by the rapid loss of heat. It has been shown on animals that eight hours of cooling each day (25 deg. fahr. drop) produces a maximum stimulating effect on energy level. So here we are, deluding ourselves into believing we are protecting ourselves against climatic effects when really we are greatly intensifying them by our fetish for open-air sleeping.

"As for ordinary indoor heating of buildings, rarely do two people find themselves in perfect accord. Grand-

mother likes the house kept at 80 deg. fahr. with no drafts; seventeen-year old Bob is roasting if it gets above 70 deg. fahr., while the rest of the family range in between. Aunt Alice's neuralgic pains come back with the slightest draft or chilling and so the home and office warfare goes merrily on.

"The basic differences behind the varying temperature needs for comfort in people are due to differences in actual metabolic level. There is no point in differing over this matter of comfort temperatures, for the individual cannot stimulate or smother his inner fires at will. *What must be realized is that not all people need the same air temperature level.*

"Attention should be paid to these individual differences. There is frequently enough variation in the temperature of different parts of the room to accommodate a variety of tastes. It is safe to say that no person should be compelled to work or stay where he feels chilly, since such a body reaction seems to predispose to infection in the nose and throat.

"It is found to be a matter of economy that the air be kept reasonably humid, but, so far as health is concerned there is still a considerable doubt whether the moisture content of the air is of much importance. People breathing dry desert air are in the main very healthy. We should really leave the question an open one until more well-controlled facts are available. Fresh air there must be, but without drafts, and if the cooling properties of the air are carefully controlled, we find that a smaller intake from the outside is needed.

"Vitiation of room air, except in theatres and crowded halls, is usually not so much due to the people breathing the air as it is to faulty heating systems.

"Ideal heat has been found to be that radiated out from warm bodies rather than that brought by warm air circulation. With radiant heating the air temperatures can be kept much lower, and with moderate air renewal, vitiation does not occur. Furthermore, with radiant heat, humidity plays little part and may for practical purposes be disregarded.

"*The ideal would be a moderate heating of all wall or ceiling surfaces.* Perhaps future construction will see provision for such innovations. It would be found economical in the saving of fuel, for low air temperature and small intake from the cold outside greatly lessens the heating required. Electrical or warm water radiators should prove best.

"An intelligent approach to the heating problem on an individual basis is far more to be desired than hard and fast rules for air temperature and humidity.

"In northern regions then, the major consideration in conditioning indoor environment has to do with checking the rate of body heat loss and easing the body stress through the winter season. Summer cooling is needed *ONLY* for severe heat waves, but in the main, northern people need the relaxation brought by moderate summer warmth. That is their only rest period of the year, and *it would be a biologic mistake to provide such summer cooling as would keep up their body combustion anywhere near the winter rate.*

"There is, therefore, I believe, an urgent need for the development of conditioning methods, for both winter heating and summer cooling, whereby heat loss from the body can be properly controlled *without regard to air temperatures or humidity.* For a couple of years I have had an idea such an end could be achieved through radiant heat means, and this winter I have had a chance to demonstrate that it can actually be done.

"Suffice it to say that one can be made quite comfortable at air and wall temperatures of 92-95 deg. fahr. by removal of the body's heat as radiant heat, and likewise at low air temperatures (30-50 deg. fahr.) comfort can be readily achieved by radiant heat introduction. Heat reflective wall surfaces are an essential part of the set up, for various experimenters have found the cost of cooling or warming all wall surfaces too prohibitive for practical application. With heat reflective wall surfaces, however, wall temperatures become unimportant, in fact, the walls assume air temperature levels. Here then is a hint of changes in conditioning methods that will greatly lessen fuel consumption by obviating the necessity of heating air mass or building materials. Insulation needs will also be greatly reduced and year round control brought down within reach of the most modest home owner. This idea sounds utopian but in actual test is proving feasible.

Effects of Barometric Pressure Changes

"Preliminary hints have been noted that barometric pressure changes may be equally as disturbing as the changes in temperature. Within a few years we may be as much interested in pressure control inside our buildings as we are now interested in temperature.

"These ideas may be rather far afield from the usual considerations associated with present-day air conditioning. This is because I view the matter of environment from the aspect of purely human needs. The engineers opened up this conditioning field many years before medical and physiological scientists became interested in its possibilities and significance for human welfare."

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Contrast Between Indoor and Outdoor Air Temperatures Should Be Reduced

The whole point stressed by Prof. Mills is the desirability of lessening the contrast between outdoor and indoor temperatures for both winter and summer conditioning and to do this he proposes to increase the proportion of heat removed from the body by direct radiation to cooler surrounding surfaces in summer and to make up for the drop in indoor temperature in winter by providing more radiant heating surface surrounding the body. The effect of these surrounding lowered or raised surface temperatures will be, of course, to change the proportions of heat given off from the body by radiation, convection and evaporation.

As the radiation loss from a nude subject is about twice as great for a room temperature of 59 deg. fahr. as it is for a room temperature of 79 deg. fahr., the need for providing some other governor for the human power plant when we raise or lower the air surrounding it can be seen.

Increase in wall temperature will

therefore produce a decrease in radiation loss from the body in winter, and conversely, a decrease in wall temperature in summer will increase the radiation loss from the body. This does not mean that we have to develop entirely new theories and practices of heating buildings.

RADIANT HEATING IN ENGLAND

The theory and practice of Radiant Heating were introduced in England many years ago by Arthur H. Barker, Consulting Engineer, London, by whom they were outlined in a paper to the American Society of Heating and Ventilating Engineers in January, 1932 (Heating, Piping and Air Conditioning, March, 1932).

In that paper Barker maintains that "it is now generally accepted in England that there is a substantial difference in the feeling of comfort at the same total rate of heat loss from the body according to the way in which it is abstracted. The higher the radiant and the lower the air temperature, the greater is the feeling of freshness for the same rate of heat loss.

"The calculation of the heat requirements is, therefore, quite different in principle from those usual for convective heating. Instead of calculating the heat lost by conduction through the walls, an endeavour is made to estimate the surface temperatures which the various parts will assume.

"If the surfaces are too cold they will absorb too much radiant heat from the body. By introducing a number of smaller surfaces maintained at a high temperature and disposed in suitable positions about the room, the negative radiation from the cold walls and windows is neutralized, and the mean radiant temperature is raised to the desired value. The problem, therefore, is first to find the value of the radiant temperature which would absorb a desirable amount of radiant heat from the body and then to determine a suitable amount of surface, maintained at a suitable temperature and placed in suitable locations to raise the mean radiant temperature to that desired value.

"It is necessary also to calculate how much heat will be given off by the same surfaces by convection and thereby to ascertain whether this amount of convected heat is adequate for warming the air corresponding to the degree of ventilation required. If it is not, then additional convection surfaces must be introduced to make up the balance."

With regard to the system generally Barker admits in that same paper that certain factors can only be determined empirically and therefore a good deal of observation and research is necessary in the climatic conditions concerned before any authoritative figures can be established, but he sums up the advantage of the system by pointing out that "the principle feature of radiant heating is that *it raises the air temperature less than other methods.*"

In England the use of the panel system of heating has been increasing rapidly for some years. In many of the installations pipes are embedded in walls or ceiling and hot water forced through them to maintain the surfaces at a temperature of about 75 deg. fahr. The increased surface temperature decreases the heat loss

from the body by radiation, and thereby permits the maintenance of a lower room temperature, which results in fuel economy.

As has been shown there is another benefit which is of more importance than the purely economic gain in that the contrast between the air temperature in such buildings and that of the outdoor air is very considerably reduced thus decreasing the effect of the climatic drive.

The use of radiant panel surfaces in England heated by electric power has also been developed, and this feature of the system is one in which I suggest your association should be particularly interested. Whole buildings have been heated by electric power at what appear to be reasonable costs.

In the early examples of this system black iron heating pipes with welded joints were buried in the structural walls, ceilings and floors. A study of the details of one of the most important installations in London in 1928 did not impress me favorably from the structural angle, although I had been an advocate of the idea of controlling body comfort by surrounding surface temperature for a long time.

Since that time the trend has been towards the development of applied heating panels with better access to the supply and return mains and greater facilities for making repairs in the panels themselves.

I feel certain that any development of the use of electric power for either heating or cooling surfaces will be along the lines of prefabricated units, with installation cost on the job reduced to a minimum.

Present Position of Convection Heating in Canada

But before discussing possible future variations in our heating and cooling methods, let us consider where we are at now with present systems.

In the first place we should note that the winter and summer mean temperatures over large portions of the most densely populated parts of Canada and the Northern States are not far below or above the optimum range for men which both Huntington and Mills agree is from about 38 deg. fahr. to 64 deg. fahr. For example at Toronto the mean temperature from October to April is 32 deg. fahr. and from May to the end of September 61.5 deg. fahr.

Temperature records kept in a large shed between Toronto and Hamilton which I planned in 1928 prove that buildings can be built so that they can be maintained at about the outdoor mean temperature both winter and summer, with practically no assistance from either a heating or a cooling plant. In that building the temperature range winter and summer has been about 30 deg. fahr. to 80 deg. fahr.

Seventy Per Cent. Reduction in The Size of Heating Plant Quite Practicable

This building and others built from our plans have demonstrated beyond any question of doubt that a reduction of 70 per cent. in the size of the heating plant, from what would be required under ordinary construction methods, is quite practical. Furthermore, the chart showing the results obtained in our Prince Edward Island Hospital at Charlottetown show that in build-

ings of this type of construction from two to five days elapse after a sudden drop of outdoor temperature before any rise in the temperature of the heating water is required. This job shows a water temperature range of about 108 to 110 deg. fahr. in mild weather to about 130 deg. fahr. at 20 deg. fahr. below zero outdoors, as compared with 140 to 220 deg. fahr. in other forced hot water jobs of ordinary construction.

Any additional cost of such types of construction as we have used in these and many other jobs is more than met out of the reduction in the cost of the heating plant alone.

These buildings also show reductions in the annual cost of heating of from 60 to 75 per cent. as compared to similar buildings of ordinary construction.

Wall and Glass Surface Temperatures

The demand for higher wall and glass surface temperatures in winter is already being partly met in buildings like the Prince Edward Island Hospital, Charlottetown.

The following table gives the comparison between ordinary construction results and those at Charlottetown:

From the foregoing it is obvious that with improved wall, window and roof construction, that gives a reduction of 70 per cent. in the size of the heating plant requirements, the amount of supplementary radiant heating to be provided would not be very great, and also that individual rooms and portions of rooms could receive special consideration that would give much better results than can be got when the heating of air mass is the only controlling factor.

Summer Cooling

Possibilities for summer cooling in buildings of this type can be seen by studying the records of three experimental huts located about 14 miles south of Hamilton. These huts were of different construction, but were similar in size and exposure. They had no artificial cooling equipment and on the 6th of August, 1931, showed temperatures as follows: (See table on next page).

During the month of August, doors and windows were opened at 5 p.m. and closed at 6 a.m. Above readings were made at 12 noon.

Results in Existing Buildings

These construction methods used by us at the Toronto Western Hospital for additions of 1,880,000 cubic

All temperatures in degrees fahrenheit

Air temp. indoors	Air temp. outdoors	P.E.I. inside wall surface temperature	Ordinary inside wall surface temperature	P.E.I. inside glass surface temp.	Ordinary inside glass surface temp.
70	0	68.4	56.9	56	17.3
60	0	56.9	48.8	48	14.8
50	0	47.4	40.7	40	12.3

	Inside surface temperatures of exterior walls				Air temp. in centre of hut	Air temp. outdoors	Hours Sunshine
	1	2	3	4			
Hut No. 1	85	84.5	85.5	86	86	92	11
Hut No. 2	74	74	74.5	74.5	71	92	11
Hut No. 3	86	86	86	86.5	88	92	11

feet of new building to an institution that had beforehand about 1,813,000 cubic feet, coupled with the greater efficiency of a new power plant, have added less than $1,000.00 per year to the fuel cost for heating purposes. Here the higher surface temperatures inside the building make it extremely difficult to control the air temperature to satisfy all the occupants throughout the whole of the building in mild weather with a vacuum steam system designed to meet air temperature conditions only.

Similarly at the Hospital for Sick Children, where we planned two new operating rooms with high inside surface temperatures at the walls and ceiling in winter and correspondingly lower surface temperatures in summer, the experience during winter use has been that the difference between the surface temperatures in the new rooms and those in the old rooms creates a feeling of discomfort when the air in the new and old rooms is kept at the same temperature, even when the air in the new rooms is changed much more rapidly than in the old. These changes in surface temperatures call for a considerably lower air temperature in these new rooms to give anything like the same rate of body cooling.

However, as these rooms were built to meet the increased demand for surgical accommodation during the school summer holiday season, the lower surface temperatures of the walls and roof in the new rooms compared with that in the old rooms will have the desired result of making them more comfortable than the old during the spells of very hot weather that are frequently experienced during the school holiday months.

The foregoing illustrations of what has been done with new construction methods coupled with commonly accepted heating practice show that the possibilities suggested by Prof. Mills are neither beyond our economic limits nor impractical in execution.

His demand for a moderate heating of all wall and ceiling surfaces can be met and I am in complete agreement with him in his contention that an intelligent approach to the heating problem on an individual basis is far more to be desired than hard and fast rules for air temperature and humidity.

LIGHT REFLECTION

When we come to provide wall and ceiling surfaces to reflect radiant heat we must not introduce another problem — light reflection — that

might be even more serious in its reactions on health than are the effects of our present systems of heating.

Those who do much night driving know the nervous strain caused by the myriads of light reflections from wet pavements, street and vehicle lights, etc., and I can remember no more uncomfortable experience than sitting in an old country church with its shiny reflecting surfaces of varnished woodwork and other interior finish that did not need a soporific sermon to induce closing of the eyes to get relief from the strain.

Prof. Mills has advised me that his experiments have been made with heat reflective aluminum foil.

One layer of foil with its surface exposed to a room would not decrease the rate of heat transmission through walls and roofs to effect any very marked economy in heating under our wide fluctuations of outdoor temperature. If then, to avoid light reflection in the room and to obtain sufficient resistance to heat transmission, the heat reflecting surfaces have to become part of a composite wall structure with air spaces to take advantage of several layers of reflecting surface material, other problems are likely to confront us.

The most serious difficulty is that of condensation of moisture in such spaces. In cold weather the dew point of the air must lie somewhere between the temperature on the inside surface of the wall and that on the outside surface.

Claims are made that in this kind of construction this problem has not caused any trouble, but more experiments and research studies are needed under practical building conditions with wide fluctuations in outdoor temperature, before it can be decided that in this method we have found a satisfactory solution of this difficulty of making any worthwhile reduction in the amount of heating plant required, and at the same time reducing the harmful results of our climatic stimulation.

* * * *

SUMMARY

The problem before us then is to reduce the effect of our climatic drive by creating comfortable conditions inside our buildings with the minimum difference between the temperature of the air indoors and outdoors.

In doing this we must make better provision for the widely differing requirements of individuals with varying heat-producing capacity.

I know of no group that should be more interested and more actively engaged in trying to find a solution of this problem than our Canadian Hydro Electrical Associations and corporations.

You have the most convenient heating and cooling medium available in this country. Hitherto buildings have been constructed with so little regard to our severe climatic conditions that heating demands were far too exorbitant to be met electrically. Now, however, enough work in various parts of the country has been done, as I have indicated, to make such a tremendous reduction

in the heating demands as to create an entirely different situation for hydro-electric enterprise.

Oil could be heated to high temperatures over short periods and stored in well insulated tanks to provide heating media at low temperatures for use over each 24-hour day in winter.

We waste enough carbonic gas to the atmosphere every year to supply a tremendous amount of dry ice at comparatively low cost.

These are just indications of many possibilities that would more than justify the cost of a research programme by your association.

Experiments in a few small buildings, specially constructed to meet our Canadian requirements, would soon develop economic uses for all the power you could generate, and would at the same time provide a stimulus to the construction industry which has been so badly hit in recent years and can still benefit from new ideas.

If such a contribution on your part helped in any way to overcome the disastrous effects of our climatic drive as outlined by Prof. Mills, the work should be undertaken apart altogether from any possible immediate economic benefit.

Personally I would be glad to do anything I could to help any group that would undertake such a programme, and I feel certain that Prof. Mills would also be perfectly willing to co-operate in such a study.

Home Improvement Plan

By Elliott G. Strathy, District Representative,
Home Improvement Plan, Toronto

(Presented to the Association of Municipal Electrical Utilities at Niagara Falls, Ont., June 29, 1937.)

IT is a great pleasure to have the opportunity on behalf of the Ontario Advisory Committee to explain to the members of your Organization the Home Improvement Plan. As you represent practically every town in Ontario, no doubt many of you are familiar with some of the features of the plan through the officers of your local committees and I hope that my remarks will not be covering too familiar ground.

In order to fully understand the Home Improvement Plan, a full knowledge of why and how the plan came to be formulated, is essential.

About a year ago, the Right Honorable Mackenzie King, the Prime Minister, in his efforts to find a solution for the Unemployment problem, called upon A. B. Purvis, President of Canadian Industries Limited, to head a National Employment Commission. Mr. Purvis and his fellow-members immediately went to work, and, after a careful study of the classes of people out of employment and the methods used in several countries to cure unemployment, decided that most could be done in the shortest possible time by the speeding up of the building industry. They found great progress had been made in England in financing new houses but there was already a Canadian Housing Act for assisting in the financing of new houses and the National Employment Commission decided that the quickest and best results in putting men back to work could be obtained through employment made by improvements to existing dwellings. The Commission also found that efficient modern legislation for financing the renovation of existing dwellings had been in successful operation in the United States for several years. The Commission's recommendations for a Home Improvement Plan were therefore largely based on the American Act.

What is the Home Improvement Plan?

It is an arrangement by which an approved home-owner may borrow from a Bank on a note at a reasonable rate of interest, money with which to repair or improve the home—repaying in monthly or other convenient payments.

What is an approved home-owner?

A Resident in Canada who owns his home—perhaps subject to a mortgage, but who has the reputation for paying his debts in the past and who has sufficient income to repay the loan in the agreed instalments.

What is the reasonable rate of interest?

The note is discounted at 3¼ per cent per annum which means, that on a note repayable in monthly instalments and drawn for one year, the rate of interest per annum on the

average amount borrowed is 6.32 per cent., for a two year loan, 6.26 per cent., and for a three year loan, 6.20 per cent. This rate is about 40 per cent. less than the rate under the American Plan and is less than 50 per cent. of the rate charged by most Instalment Purchase Plans.

What amount may be borrowed?

Up to $2,000, on a single home or for a multiple dwelling, $1,000 per apartment, plus $1,000 on the building as a whole—e.g., on a three-family house the maximum amount that can be borrowed is $4,000. The loan for amounts up to $1,000 must be repaid within three years but, for amounts over $1,000, the time may be extended to five years. The repayment of the loan is to be in accordance with the way in which the borrower's income is received. For one whose income is received weekly, bi-weekly or monthly, the loan would be repaid in monthly instalments (not less than $5,00 per month). For one whose income is seasonal such as a farmer the repayments would be made accordingly.

What is the Government Guarantee of which we hear so much?

The Dominion Government Guarantee is really a private matter between the Government and the banks. To encourage the banks to make these loans—and they are really very different from what was considered good banking practice—the Government guarantees each bank against loss to an amount equal to 15 per cent. of the total amount of the loans made by that bank.

How may one obtain a loan?

There are two methods: First, where the house-owner applies directly to the bank himself. In this case, he obtains from a builder or other source of information, an estimate of the cost of the work which he wishes done. He then gives this to his banker and fills out an application form which gives particulars of the property, its estimated value, mortgage, if any, the amount of his income, the amount of his fixed expenditure—in fact, a statement of his financial status. If this statement, when verified by the banker is such as to justify a loan and the income is sufficient for its repayment it will be granted. The owner signs a promissory note and, when the work is completed, the money will be paid over either to the owner or the contractor who did the work, as the bank manager thinks fit.

The second method is for use where the house-owner is either unfamiliar with banking practice or is engaged at his occupation during banking hours. In such a case, the contractor will make out a tender for the work on a form which may be obtained from the bank and sign it. If the amount of the tender, is approved by the owner, he signs at the bottom. The acceptance of the tender by the owner also authorizes the contractor to obtain a loan for him and if the loan is granted it also authorizes the contractor to proceed with the work and, lastly, it gives the bank authority to pay to the contractor the proceeds of the loan. At the same time, the house-owner fills out the Loan Application form, the same as referred to above. This application, together with the accepted tender, is taken by the contractor to the bank and, if the application is approved, the house-

owner then calls at the bank and signs the note. You will note, the contractor does not sign the note, nor does he guarantee it. The contractor when notified by the bank that the loan has been made, proceeds with the work and, upon completion, obtains from the owner a letter certifying that the work has been completed to his satisfaction. He takes this letter to the bank and upon signing a waiver of lien the proceeds of the note are paid over to him by the bank.

There can be no other charges made by the bank than the 3¼ per cent. discount, no endorsement can be required as long as the payments are kept up nor is there any lien or encumberance on the house while the payments are regularly made. In exceptional cases if a credit rating is required by the bank from a regular credit rating house, the bank may require the cost of this report to be paid for by the applicant.

What are repairs or improvements within the meaning of the Home Improvement Act?

Roofing, painting, decorating, insulation, floors, plumbing, heating, electrical work, sunroom, bathroom, and kitchen renovations, in fact, any permanent project to modernize or improve a home, already built, and so add to its value. A separate garage on the same property is also considered a home improvement.

On the farm, lighting or power plants, sewage systems, new barns, silos and fixed farm equipment may also be purchased under the plan. A detailed list would take several pages but the foregoing broadly covers the definition of home improvement.

Now what are the purposes of the Home Improvement Plan?

They are twofold, First, to take men off relief rolls and put them onto pay rolls and Second, to enable residents of Canada to repair and improve their homes.

Is the Home Improvement Plan a scheme merely to benefit the building industry? No.

Then why was the building industry chosen to put men back to work?

The ramifications of the building industry are so wide spread that a revival in this industry will benefit nearly every other industry.

From 50 to 60 per cent. of those on relief were connected with the building industry.

One ninth of all industrial employees are normally engaged in the manufacture of building materials.

One tenth of all freight cars were regularly engaged in the transportation of building material.

Seventy-five cents out of every dollar spent in building goes into labor—on the job, in the factory making materials incorporated in the house, in the quarry, brickyard, mine and forest.

Also in the United States from where this plan was adapted it was found that for every dollar expended on home improvement through Home Improvement Loans, three dollars were spent by people without borrowing. The sight of one person making repairs or additions to his house, encourages owners of nearby properties to make repairs or improvements to their own and the volume of home improvements increases like a snowball.

But after all this you may still say "But I do not need to borrow money for Home Improvement, so why should I be interested in the Home Improvement Plan? No matter who you are, if you are a resident of Canada, you will benefit by the successful operation of the Home Improvement Plan. Its effects are so wide spread it will take the working man off the relief roll and put him on the pay roll. To the contractor and building supply man who is wide awake enough to take advantage of the Plan and go after the great volume of new business which he cannot finance himself but which can be financed under the Home Improvement Plan, it will provide ample work—more than he can take care of with his present force—and with increased profit to him.

To the retailer will go the benefit of increased business. When one makes repairs to one's home one seldom stops at structural alterations. New blinds, curtains, rugs, furniture and other furnishings of all kinds are bought too. Do you not remember when you last made repairs or alterations to your house that in addition to the structural changes you had to buy furnishings. The majority of building workmen are skilled mechanics. When employed at their trade they earn good wages. For some years past they have been unable to replace worn clothing, furniture or household goods, nor have they had money for the better foods or luxuries. Give them more work and they will become regular purchasers of all kinds of goods. This increased demand will itself create an additional demand for more labor and more goods.

To the home-owner without cash it gives the opportunity of making needed repairs or improvements now at a cash price, paying for them in monthly or other instalments without waiting till he has saved enough to pay cash by which time deterioration will have increased the cost far beyond the small cost of interest on a Home Improvement Loan.

To all who are tax-payers and this means all of us, take men off the relief roll and your taxes, municipal, provincial and federal will be cut by an amount that will astonish you.

In each province Mr. Purvis selected a chairman of a provincial committee, each of whom has gathered around him able business and professional men and women to further the work of the National Employment Commission. The Ontario Committee is most fortunate in having as Chairman Ryland H. New. The success of his leadership is shown by the outstanding lead that Ontario, over all the other provinces, is showing in Home Improvement work.

The Provincial Chairmen, in turn, have selected local chairmen and in practically all your localities there are public spirited citizens serving on local committees, giving their time and money freely to promote Home Improvement—not encouraging people to incur debts they cannot repay, but making known the true facts of the Home Improvement Plan by publicity and education and encouraging people to make needed repairs and improvement to their homes and thus provide work. When you go home will you not help these men and women and back up their efforts to make your town a better town and your country a better country in which to live?

Association of Municipal Electrical Utilities

Report of Committee on Accident Prevention and Health Promotion

This Committee was named subsequent to the last convention of the Association held in Toronto during the first week of February. Since formation the Committee has had no meeting, but through correspondence has ordered the Secretary of the Association to have printed 750 copies of a booklet "Rules and Instructions for Safety of Employees", using as copy the booklet so named and issued by the Toronto Hydro-Electric System. These booklets have been prepared and may be obtained from the Secretary of the Association at a price of twenty-five cents per copy. Your Committee believes that each Municipal Commission should supply a copy to each of its employees concerned with safety measures.

This booklet is the result of many years of practice and experience, and should assist in materially reducing the number of accidents chargeable to the Municipal Systems. Apart from the cost of accidents to be paid by a Municipal Commission, whether under Schedule 1 or Schedule 2 of the Workmen's Compensation Act, each Municipal Commission is vitally concerned in the reduction of the number of accidents which not only cause suffering and anxiety to the employees and their families, but which also disrupt the working force of the Municipal Commissions.

The Committee wishes to point out to each Municipal Commission that the procedure of the past whereby the Electrical Distribution Systems operating under Schedule 1, Class 22, of the Workmen's Compensation Act, were protected as though covered by a mutual accident insurance, has now been modified for all Classes in Schedule 1. A preferred rate of assessment has been established for those whose cost of accidents has not exceeded in the year under consideration, 60c per $100 paid in assessment, or in other words has a cost ratio of .60. If your Municipal System has a cost ratio of more than .60 it shows that your accident record is not what it should be. There is only one way to lower the assessment rate to your Municipality, and that is to prevent accidents.

In a small booklet issued by the Workmen's Compensation Board giving the 1936 preferred (adjusted) rates and the 1937 provisional rates we note the following:

"At the suggestion of a large number of employers a method of rating has been adopted which takes into account to a small extent the individual experience of the employers covered by the Act. The system is applied as follows:

(1) Each employer whose cost ratio experience for the next proximate adjusted year shall be .60 or less shall pay the preferred rate;

(2) Employers with other cost ratio experience for the next proxi-

mate adjusted year shall, for each .03 cost ratio or part thereof above .60, pay an additional 2 per cent. of the preferred rate, but the total rate to be charged in any one instance shall not exceed 200 per cent. of the preferred rate.

For the year 1937 "the next proximate adjusted year" is 1935, with the result that a firm with a bad accident experience in the year 1935 may have its adjusted rate doubled for 1936, and the increased rate on such firm will be applicable to reduce the rate paid by those firms having a good experience. Each year is treated separately, with consideration for former years' cost experience.

The result of the application of this scheme is that the preferred (adjusted) rate is somewhat lower than the average cost rate above referred to, and that preferred (adjusted) rate appears hereafter as the adjusted rate for 1936, and according to that rate so set the total amount of assessments to each employer will be fixed for that year.

It is hoped that the new method of rating will (1) so stabilize the rates that they will no longer fluctuate violently; (2) place on each employer some portion of the burden of his own bad experience; and (3) reward to some extent those employers who in each year have a favorable accident experience."

This change in procedure on the part of the Workmen's Compensation Board emphasizes the necessity of the prevention of accidents in order that this factor of the cost of the distribution of power by each Municipal System may be kept to a minimum. It is believed that the Board, in thus bringing to the attention of each Commission the cost of their own accidents, has taken a progressive step which should materially reduce the assessment of all Commissions with a good cost ratio.

This Committee proposes to become an active one, hoping to work out some solution for the unusual accidents of the present, as the accidents to linemen have been materially reduced during the past few years.

Respectfully submitted,

(Signed) P. B. YATES,
Chairman.

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Sir Adam Beck

By Roy N. Adams, Distribution Section, Electrical Engineering Dept., H. E. P. C. of Ont.

As my contribution to to-night's program I desire to pay tribute to the life and work of the late Sir Adam Beck.

It has been said of Adam Beck that he was "a great man and a very great Canadian". Now, we have some queer ways of measuring greatness in this world. A warrior carves his ruthless way to world conquest, and history presents him to us as Alexander, the Great. A tyrant unites his people in the crushing grip of an iron hand, and we remember him as Frederick, the Great. The accumulation of wealth ensures a lasting, though dubious, fame to our Carnegies and our Rockefellers. Sir Adam Beck's claim to greatness does not depend on such questionable yardsticks of success but rests, rather, upon the sure and solid foundation of service to his fellow men. Measured by that standard, Sir Adam justly earned the enviable title of "Ontario's greatest son".

Adam Beck was born June 20, 1857, in the village of Baden, which had been founded by his father. He was the fourth child of Jacob Beck and Charlotte Hespeler, pioneer stock of old Waterloo county. The boy was educated in the local school at Baden, at Dr. Tassie's school in Galt and, later, at the Rockwood Academy and Western University. At an early age he joined his father in the foundry business at Baden. The failure of the foundry in 1879 led to his coming to Toronto to enter the employment of the Morrison Brass Works as a clerk. His distaste for the humdrum of clerical work is evidenced by the fact that one year later we find him starting a box factory at Galt. The ensuing prosperity of this venture soon led to the removal of the business to the larger centre of London.

Fifteen minute address delivered April 17, 1937, in Annual Oration Contest of the Ruskin Literary and Debating Society, Hart House, Toronto.

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Vol. XXIV No. 8
AUGUST, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

In 1898 he married Miss Lillian Ottaway of Hamilton and thereby achieved one of his ambitions expressed as a youth, namely "to marry the most beautiful lady in Canada".

With the turn of the century, Adam Beck entered upon a distinguished public career that began with his election as Mayor of London in January, 1902. In May of the same year he was elected to represent his adopted city in the provincial legislature. In the following month of June he took an active part in a conference of manufacturers held in Kitchener, then known as Berlin, to discuss the possibilities of bringing cheap electric power from Niagara Falls to the manufacturing centres of the province. That conference has been regarded by many as the real beginning of Hydro in Ontario. However that may be, we know that it was not long until the Hydro-Electric Power Commission was formed with Adam Beck as its first chairman, a position he held with distinction until his death in August, 1925.

The name of Sir Adam Beck has been so closely associated with Ontario's hydro-electric development that one is apt to forget that he had other interests that vied with Hydro for first place in his thoughts and his affections. Three such interests were his love of horses, his contribution to the civic welfare of London, and his philanthropic activities in the field of public health.

Adam Beck was always a true sportsman who played the game for the game's sake. In his youth he engaged in the popular pastimes of baseball and lacrosse. He was an ardent enthusiast at tennis. But it was in the realm of horsemanship that he won a world-wide reputation as a sportsman. Time limits us to-night to little more than the mention of such names as "Rosebery", "Sir James", "Frontenac" and "Melrose", horses that carried the purple and gold of their master's stable to fame on the tan-bark rings of two continents. Lord Lonsdale termed "Melrose" the best horse of its type in the world.

Sir Adam's achievements on the track rivalled his victories in the show-ring, and with such well-known mounts as "Generosity" and "Snapshot" and "Photographer", particu-

larly the latter, he came very close to achieving another of his boyhood ambitions—"to win the King's Plate".

That Adam Beck was regarded as one of the best judges of horses in Canada is attested by the fact that, despite his German ancestry, he was appointed Canadian Remount Commissioner at the beginning of the war. As such, he made a worthy contribution to his country and to the allied cause by purchasing thousands of horses for the Canadian Expeditionary Force in France. He bought good horses at a price that was fair to the vendors and to the government of Canada. As Remount Commissioner, he strayed from the principle of "service at cost" to service at no cost to the people of Canada, as far as his own time and effort was concerned, by returning uncashed the substantial cheques received from Ottawa for this work.

The name of Sir Adam Beck in the world of horses was inseparably associated with those of Lady Beck and their daughter Marion. These were names to conjure with in the horse-shows of their day.

Then, Mr. President, as I have already suggested, another phase in the life of this great Canadian that is apt to be forgotten in the closeness of the connection between his name and Hydro, was the service that he rendered his fellow-citizens of London as their Mayor and as their representative at Queen's Park, Toronto. As a member of the legislative assembly he achieved with distinction to himself and with profit to those whom he represented in the House, still another of his youthful ambitions—"to be in politics".

As Mayor of London, one of his primary tasks was the electrification of the London and Port Stanley Railway. He thereby turned a municipal white elephant into a profitable, publicly-owned enterprise that gave the people of London cheap, fast, clean and comfortable transportation to and from Lake Erie. He made many other contributions to the civic welfare of London but time, again, limits us to a passing reference to the famous Beck artesian wells that constitute the city's water supply. The fight waged by Sir Adam (and he was ever a fighter) to have his way in this matter was interpreted by his enemies as stubbornness and by his friends as service. It was typical of Adam Beck that he paid thousands of dollars out of his own pocket to have that stubborn way. In the transaction, the people of London received the benefit of a supply of millions of gallons of clear, pure, spring water rather than an inferior brand of filtered river water that was advocated by the opponents of Sir Adam's plan.

Closely allied with the matter of London's water supply was his interest in the general problem of public health. As trustee of the City of London hospital board he made possible a much-needed enlargement of Victoria Hospital. He was appointed president of the London Health Association in 1909. In that capacity he provided the first accommodation in Western Ontario for the treatment of tuberculosis. Within little more than a year of his appointment to that post a sanatorium

was opened at Byron, a few miles from London and, as unit after unit was added to "the San", as it was affectionately termed by Sir Adam and Lady Beck, it gradually assumed the proportions of a magnificent obsession in their lives, an absorbing interest that, for them, rivalled the great public enterprise of Hydro. A grateful host of men and women of Western Ontario revere the names of Sir Adam and Lady Beck for the manner in which they lavished their love, their time and their relatively modest wealth on Byron.

The concluding line of Sir Christopher Wren's epitaph enshrined in the marble portico of St. Paul's Cathedral, of which he was the architect and builder, bears the famous words, "If you seek his monument, look around you". That these same words may be written over against the life and work of Sir Adam Beck must be apparent to every citizen of Ontario. I have tried to show you that greatness came to him because he lived among us as one who served in the realms of sport, citizenship and philanthropic endeavour. His contribution to these phases of life far exceeded the achievements of the average man. But the crowning glory of Sir Adam Beck's life must ever remain the creation of Hydro in Ontario. He successfully applied the principles of public ownership and service at cost to the hydro-electric development of this province. In Hydro—as in his other interests, Sir Adam dedicated his dynamic personality to the service, rather than the exploitation, of the people.

Mr. President, I can leave you no more striking portrait of Sir Adam Beck, no more accurate measure of his greatness, than is to be found in the words of the poet,

"God give us men. A time like this demands
Sound minds, great hearts, true faith and ready hands.
Men whom the lusts of office cannot kill;
Men whom the spoils of office cannot buy;
Men who possess opinions and a will;
Men who love honour, men who cannot lie".

"Lighting for Safety" Needed on Streets and Highways

By Dudley M. Diggs, Special Representative of the General Electric Illuminating Laboratory, Schenectady, N.Y.

(Presented to the Association of Municipal Electrical Utilities at Niagara Falls, Ont., June 29, 1937)

DO the people of Canada need greater night traffic protection on their city streets and main highways contiguous to these cities? If the automobile accident experience in the province of Ontario is typical of that in the other populous provinces of Canada, there is an immediate need for greater night traffic safety.

Half (49.1 per cent.) of the fatal accidents in Ontario for the past six years (1931-36) occurred during dusk and darkness, according to the Ontario Department of Highways.

Why should such a large percentage of fatal accidents occur during dusk and darkness when only one-fifth of the total traffic flows then, assuming the percentage of night traffic is no greater than it is in the United States?

During this six-year period, fatal accidents during dusk and darkness showed an upward trend. The trend of fatal daylight accidents is down. The trend of urban (including cities, towns, villages) fatal accidents is stationary, yet the trend of rural (all King's Highways, county and township roads) fatal accidents is up.

As for acidents in which no fatalities occurred, the trend of all dusk and darkness accidents is up, and the trend of all urban and rural accidents is up.

Compared With the United States

How does this accident experience compare with the situation in the United States? More than one-half of all fatal U.S. accidents occur after sunset. Yet only one-fifth of the total traffic flows then. In other words, night driving in the United States is at least four times more dangerous than day driving, and on many highways it is from six to ten times more dangerous.

Night accidents took about half the lives claimed in smashups in 1930 in the U.S. Today, these same night accidents claim about 60 per cent. of the lives lost.

From 1930 to 1935, city deaths declined 10 per cent. in the United States (the trend of urban fatal accidents in Ontario is stationary). During this period deaths on the "open road" increased 28 per cent. (The trend of rural fatal accidents in Ontario is up).

Consider Decreased And Inadequate Visibility

Almost all warnings are infinitely superior to the scant warning of danger ahead provided by our headlights. The railway engineer travel-

ing along at 60 miles an hour has block signals to warn him of danger 60 seconds before he reaches it—plenty of time to bring his train to a halt.

But the motorist has but a short 1 to 5 second warning of dangers that lie in his path, or approach him from any side. It is the seconds that count in driving at night.

The present average automobile headlights enable the average driver to see the average "dark" object about 150 feet ahead. Here is how the trap is sprung. A car going 50 miles an hour goes 73 feet each second. When a "dark" object suddenly looms up only 150 feet ahead, it means that there are but two seconds in which to see, to comprehend the danger, to decide to take the foot off the accelerator and slam it on the brake, to judge the size and direction of the object, to blow the horn, and to turn the steering wheel—all at once.

The warning is too short. A car traveling 50 miles an hour travels from 186 to 243 feet after the warning is transmitted to the brain by the eyes, and before the car can be brought to a standstill—depending on the condition of the brakes, the road, and the driver. And at that speed you do not see the danger soon enough. It is just too late and just too bad.

Is Present Lighting at Fault?

Man must produce artificially his own light for the streets and highways at night. This light can be made available either through automobile headlights or permanent lamps mounted on standards along the thoroughfares.

One need but look at the facts to find out that proper visibility is not being furnished by all headlights nor by all street lamps. To reduce the night accident rate and make it conform with the daytime rate then would seem to be a matter of providing proper lighting (visibility) which will enable motorists and pedestrians to travel without encountering any more hazards than those prevalent during the daytime.

Will Lighting Reduce Accidents?

Have we any proof that various intensities of illumination (visibility) will so reduce the night accident rate?

Surveys by R. E. Simpson of Travelers Insurance Company in 1933 in 60 American cities tell a convincing story. The night fatality rate on streets with lighting conforming to the Illuminating Engineering Society's Code was 9 times higher than the day rate. As the level of illumination dropped below the code requirements, in three successive stages of 25 per cent. each, the night fatality rate became respectively 15, 20, and 24 times higher than the day rate.

But why, with the lighting conforming to code, was the rate 9 times higher than the day rate in the first place? It need not have been, as Mr. Simpson proved in a three-year traffic fatality survey on thoroughfares with lighting intensities which brought the night rate down to .29, as compared with a day rate of .21 per million vehicle miles

in one case; on two other streets, with the same lighting intensities, the night rate was slightly below the day rate during all three years. The principle of street lighting is not at fault. As Mr. Simpson has explained, "The trouble is that the principle has not been thoroughly applied in actual practice."

A report recently issued by L. J. Schrenk, general superintendent of Detroit's Public Lighting Commission, proves that improved lighting can drastically reduce an abnormal night fatality rate. On 31 miles of streets where the death rate was the highest in the city for more than two and a half years, improved lighting cut the night to day fatality ratio from 7 to 1, to 1.25 to 1.

When permanent lighting systems were turned off along the Mount Vernon highway leading into the capital of the United States, night accidents jumped two and a half times what they were. When all lights were in service, records show that nine night accidents occurred over a six-month period. When all lights were turned out, and with the same number of vehicle miles traveled, 22 night accidents were recorded over a similar six-month period the following year.

In New Jersey we find two comparable highways in Route 25, which is lighted by permanent lamps, and Route 26, along which motorists must depend upon their headlights to supply adequate visibility. Surveys in 1934 by Arnold H. Vey, traffic engineer for the state, show that on Route 25 (lighted) there were 2.69 night accidents per million vehicle miles traveled. Route 25 was found to be safer at night than it was by day for the rate in the daytime was 3.10. On unlighted Route 26, the daytime rate was found to be 2.42, with the night rate 7.7.

On Bay Shore Boulevard in California, night accidents dropped 40 per cent. after permanent lamps were installed. On the Troy-Schenectady highway in New York, night accidents decreased 36 per cent. when lights were put in operation a number of years ago. Records were kept for a period four years before and four years after the permanent illumination. During the four-year period of lighting, day accidents increased 9 per cent.

WESTCHESTER AND LONG ISLAND PARKWAYS

More recent surveys on the parkways in Westchester County, New York State, and on two parkways on Long Island, show an increase in night accidents when the intensity of lighting was decreased and finally turned off. In Westchester County, with lights in full service, the ratio between day and night accidents was 1 to 2.2; with lighting reduced 40 per cent., the ratio was 1 to 3.7; and with all lighting turned off, 1 to 4.8. Three-year surveys on Long Island parkways show the day to night accident ratio to be 1 to 1.4 with lights on, and 1 to 2.6 with lights off.

The Washington State Highway Department reported an enviable night-safety record during 1936 for the 2.9-mile stretch of Pacific Highway, south of Tacoma, which it lighted with sodium lights in Decem-

ber, 1935. Not one night accident was reported on the stretch during 1936, while on adjoining sections of the 4-lane highway, eight persons were reported killed at night.

To Determine Faulty Lighting

The contributing menace of faulty illumination on any street or highway can be determined by the ratio of night accidents to day accidents, the latter serving as an index of the inherent traffic hazards of the thoroughfare.

For example, let us examine the accident records on three main thoroughfares in Cleveland, Ohio. Of 31 traffic fatalities which occurred during 1936 on these inadequately lighted streets, 27 happened at night and only four in the daytime. On the average, then, these thoroughfares were seven times more dangerous to travel at night.

In fact, the hazard at night on a vehicle-mile basis was really about 21 times that by day because there was three times as much traffic in the daytime on these streets.

While there is more careless driving, more fatigue, and more drinking at night, experience in many cities has shown that any abnormal proportion of night accidents is largely attributable to inadequate illumination.

Progress in Highway Lighting in U.S.

Referring to the 1937 report of the American Road Builders Association, "Prior to 1936, little was done either in the demonstration or permanent installation of modern high-visibility systems along state routes or their intersections. But at the turn of the year, various government, utility, and safety officials found that it was up to them to provide adequate visibility for safe seeing, or at least to test out modern lighting systems to ascertain the results they would attain.

"During 1936, action toward the installation of lighting systems for the protection of the American public, motoring or walking upon state highways, was apparent in more than half of the states in the Union. The most activity was seen in Connecticut, New York, Ohio, Illinois, Missouri, Minnesota, California and Washington.

"In Connecticut the newly organized State Traffic Commission paved the way for test installations at two dangerous state road intersections, at Marlboro and Salem Four Corners. Late in December it was announced that the heavily-traveled Boston Post Road, main thoroughfare from New York City to Boston, would be lighted for six miles from the New York line to Stamford. Favorable results from these installations will undoubtedly lead to the lighting of dangerous points along the state's entire highway system.

"New York led all the states in the number of lighted highway miles added in 1936. About 33 miles of modern lighting was put in operation, including the world's longest stretch of more than 17 miles outside Schenectady. Other permanent installations were put in operation near Binghamton and Rochester.

"Safety leaders in Ohio began the establishment of 48 mile-long educational highways along dangerous stretches of the state highway system, and provided for the lighting of these stretches among other safety devices to be installed.

"Minnesota as an initial step in a program for illuminating heavily traveled routes, placed in operation permanent lamps between Minneapolis and Excelsior, and took steps toward the installation of a one-mile stretch near Bemidgi.

"Most of the installations in Illinois and California, the other states where most activity was apparent, were made at grade and cross-road intersections. However, three main highways in Illinois were lighted for one-mile stretches outside Addison, East St. Louis, and Chicago. The most important installation in California was on the new San Francisco-Oakland Bay bridge, reported to be a shining example of the highway of tomorrow."

Improved Lighting Must be Demonstrated

Our experience has shown that once the public has an opportunity to compare improved lighting with inadequate lighting, there is an immediate demand for the improved conditions. It has been said that a picture is worth 10,000 words. If that is true, then a demonstration of improved lighting is worth many times 10,000 words which may be used and still have no effect on the public.

General Electric engineers have developed three luminaries for the safety lighting of night accident zones. These are being used on streets and highways in various parts of the United States.

For two years our engineers conducted researches in the fundamentals of visibility, or "seeing for safety", on an elaborate and flexible 250-foot scale-model highway in a Nela Park laboratory at Cleveland, Ohio. They studied and measured many things. They found to just what extent obstacles are discerned on a highway as silhouettes. They learned that lighting systems may waste as much as half the illumination in so far as its seeing value is concerned. It was found that uniform illumination does not necessarily make a pavement appear uniformly lighted to the driver of a car, but the distribution of light which does produce this result was discovered.

As a result of this experimental work, the engineers had a wholly rational basis for the design of a new highway lighting luminaire. In addition to their new knowledge of the requirements, they had at their disposal a new material—Alzak— specially treated aluminum of high reflecting efficiency and permanence. And they had the benefit of new incandescent lamp developments which permitted greatly improved lamp constructions not previously possible.

The new luminaire employs a radically different form of reflector and a specially designed "bar-filament" incandescent lamp. The reflector suppresses glare by shielding

the lamp filament to about 10 degrees below the horizontal.

Properly applied, this luminaire lights a highway so that, to the automobilist, the roadway appears as a smooth ribbon of light with no areas of low visibility. To do this, light from each luminaire overlaps, not the midpoint between lamps, but the full distance to the next lamp. The light is accurately proportioned to the entire road, so that all parts of the pavement appear equally bright to the motorist.

Another incandescent luminaire recently developed gives a high efficiency in the proper lighting of those sections of the main state highways within city business and residential districts. Its shielding reflector conserves upward light and its refractor bowl distributes this light up and down the street, giving better visibility than that provided by similar equipment previously available.

SODIUM LIGHTING

Sodium units were developed by General Electric and first installed on an American highway in June, 1933. With recent refinements these units are now being used in such noteworthy installations as on the new San Francisco-Oakland Bay bridge, and along 17 miles of Route 7 at Duanesburg, N.Y. Numerous other smaller installations are in operation in all parts of the United States.

Utilizing a 10,000-lumen sodium lamp, the unit produces with high efficiency a mellow golden-orange light comfortable to the eyes. Its broad distribution makes the unit particularly effective for the lighting of the wider highways.

Results of 1937 Hydro Lighting Campaign

DURING the Summer of 1936 a canvass was made of a great many Hydro municipalities to discover those who wished to participate in the Home Lighting Campaign during the Fall and Winter season, and to find out how many municipalities would be willing to engage the service, either full time or part time, of so-called Home Lighting Advisors, whose duty it would be to do the actual work in connection with a lighting campaign.

As a result of our efforts about 35 municipalities agreed to embark on a lighting campaign and 15 representatives were selected to act as Home Lighting Advisors in these municipalities. These representatives were sent to the Lighting Institute at Nela Park for a course of training in Home Lighting and by the end of October they were ready to go to work in the municipalities listed below:

Aylmer, Barrie, Belleville, Blenheim, Bowmanville, Brockville, Carleton Place, Chatham, Cobourg, Hamilton, Huntsville, Ingersoll, Kitchener, London, Napanee, North Bay, Paris, Perth, Peterboro, Picton, Port Colborne, Ridgetown, Sarnia, Simcoe, Strathroy, St. Thomas, Thorold, Tillsonburg, Toronto, Watford, Welland, Whitby, Windsor, and Woodstock.

The Hydro-Electric Power Commission through its Lighting Supervisors assisted in the organization of a lighting campaign in these municipalities and also supervised the operations of the Home Lighting Advisors and arranged for reports to be submitted by these Advisors from time to time so that their work could be checked and the results of their activities obtained, and by the end of 1936 the municipalities and the Home Lighting Advisors were fairly well organized into the routine of conducting a successful campaign.

In order to stimulate the active work in the field, it was decided to put on a contest to encourage the Advisors to cover thoroughly every phase of their work—from promotional activities and organization to actual home calls and demonstrations, and, incidentally, to afford us a source of information by which to evaluate the entire Home Lighting Campaign.

The duration of the contest was to be from January 1st to April 30th, since many towns were closing their first campaign at that time, and prizes were to be awarded for the highest scores derived from the monthly reports sent in by each Advisor, these reports giving complete information on each Home Lighting Advisor's activities.

Home Lighting Advisors all work from Hydro or public utilities offices, contacting commissioners, Hydro employees, electrical dealers, contractors, eyesight specialists and any others who might be interested in the promotion of better lighting in order to enlist their co-operation and support, and after suitable public announce-

ment through newspapers or letters, or both, appointments were made to give demonstrations of better lighting in the home, and as demonstrations were made Home Lighting Advisors left written recommendations of improvements to be made in the lighting in each home visited.

After a month or six weeks call-backs were made to check the changes which had been effected since the first visit and the increase in installed wattage determined. These call-backs were also made to give any additional information or make any further recommendations which a customer desired. Occasionally Home Lighting Advisors were required to give shopping assistance or place orders for lamps or fixtures which consumers had difficulty in obtaining otherwise.

Illustrated lectures, with lanterns and talking pictures as well as actual demonstrations were given to Service Clubs, Home and School Clubs, Women's Institutes and Church Societies in most municipalities as it was found much easier to make appointments for home calls if some of the Science of Seeing story could be given to groups of people before making appointments to visit the home.

The Home Lighting Advisors entered wholeheartedly into the spirit of the campaign, and in spite of the many handicaps which they encountered, such as, having to travel from one municipality to the other and losing time, lack of publicity locally and lack of co-operation otherwise, the reports which we received from most of the municipalities involved present a very satisfactory picture of what can be accomplished even in a few months, and in months which are not recognized generally as the most productive in the home lighting field.

If results similar to those which were obtained in the months of January, February, March and April could be obtained for the year round the added lighting load, not to mention the goodwill created, would be more than satisfactory.

From the records obtained we find that Home Lighting Advisors conducted about 335 group meetings, exclusive of those conducted by the Hydro-Electric Power Commission staff, which latter included special illustrated lectures given at: Alliston, Chesley, Cobourg, Meaford, Paris, Port Credit, Schomberg, Strathroy, Stoney Creek, St. Thomas, Thornbury, Toronto, Whitby, Woodstock and others, and a demonstration held in the Eaton Auditorium before 1,200 persons.

In the following towns—Kitchener, London, Stratford, Strathroy, St. Thomas, Toronto Exhibition, Wallaceburg and Windsor special lighting exhibits were arranged either at local fairs or in some suitable display centre.

All of this work was necessary because in the first year of a Home Lighting Campaign a great deal of educational work must be done in order to interest Hydro consumers in the Science of Seeing story; secondly, because of the resistance created by door to door selling. Generally, Home Lighting Advisors are real door to door salesmen and without the preliminary educational work they would be refused admission to many of Hydro consumers' homes.

One of the biggest difficulties was to convince consumers that the Hydro Lighting Service was something to be given for their benefit and not for the purpose of selling new lighting equipment. During the period of the contest over 1,837 home calls were made and the average wattage found in the rooms (usually the living-room only) surveyed by Home Lighting Advisors was found to be 205 watts. The Home Lighting Advisors recommended increases on the average of 538 watts; the average wattage found actually installed when call-backs were made was 303 watts. The Advisors were able to make an average of two to three new calls per day, but the shortness of the season prevented more than 800 call-backs being made during the four months under survey.

There is every indication that the homes not checked have made as many changes in their lighting as those to which call-backs were made, and that further increases in wattage are being made as they can be afforded. The average of 303 watts found on call-back, we believe, is low and should be more in the neighborhood of 500 watts, since some Home Lighting Advisors reported that many of their customers mentioned changes made elsewhere in the house because of the lectures or demonstrations given, but because no provision was made for reporting these changes no records were kept and no averages produced. Other Advisors reported additional changes since the call-back was made and no definite check of results of such changes could be made.

During the four months' period Home Lighting Advisors recommended the purchase of the following equipment:

2,319	I.E.S. Lamps
600	Lamps converted to I.E.S. type
1,424	Large Shades
380	Lighting Fixtures
9,807	New Bulbs

and in the homes where actual checks were made the following actual purchases are recorded:

1,050	I.E.S. Lamps
330	Lamps converted to I.E.S. type
537	Shades
124	Fixtures
1,577	Tri-Lite Bulbs.

As previously stated, over 800 call-backs were made to check the effect of recommendations made by Home Lighting Advisors, and considering the last tabulation above it means that more than one new lamp was installed in each home checked and more than two bulbs, and one in every six bought a new fixture and five out of eight bought new shades. We know from the actual records obtained that there must be many more Hydro consumers who have made changes in their lighting equipment due in part to the educational work which has been carried on among Hydro consumers where demonstrations could not be made in consumers' homes and where records of such changes could not be obtained, and if an opportunity were given to make a survey we have every confidence that the results in increased wattage, increased consumption and in the installation of modern lighting equipment would be something to be proud of. Furthermore, our records do not include those of large centres like Windsor, London, Hamilton and

Toronto where activities were carried on by the local system and by other interests, but in a manner which prevented the keeping and compiling of records, and it has been found upon investigation that a tremendous amount of modern lighting equipment has been sold by dealers and others in these municipalities due to the educational work which has been carried on either by the Hydro, by the dealers or through the influence of the Press, and we can safely assume that at least the same proportion of wattage, the same proportion of wattage increase and equipment and selling of equipment prevails in these municipalities as in the smaller ones, if not more.

One concrete evidence of the effect of home lighting activities is contained in the report from one lamp manufacturer to the effect that over 4,000 I.E.S. lamps have been sold since November, 1936, and many new accounts opened since that time were due directly to the activities of Home Lighting Advisors. Other manufacturers report similar increases in business and give us credit for a great deal of their prosperity.

It must be remembered, of course, that many of the municipalities participating in the campaign do not merchandise, most of the sales of lighting equipment going through local stores and that the Home Lighting Advisor has been acting in a purely advisory capacity. In order to make recommendations as practical as possible it is necessary for a Home Lighting Advisor to know what equipment is available locally. We all know how easy it is to put off getting something we require because it is not available. Frequently, in smaller communities merchants have hesitated to put in a large enough stock to provide a choice for prospects or have hesitated to send any lamps out on approval and this not only dampens the enthusiasm of customers for improving their seeing conditions but prevents the Home Lighting Advisor's work becoming really effective. It would be a distinct advantage if the Local Hydro System made available modern lighting equipment to fulfil the requirements and the recommendations of Home Lighting Advisors.

It was unfortunate that some of the municipalities discontinued their lighting activities for the season before the Home Lighting Campaign was over, or rather, before the end of April, also that in some of the other municipalities the Local Lighting Advisor had responsibilities in addition to her lighting activities which prevented her giving full time to the home lighting work. There were others in which the reports were not sent in regularly enough to be included in the contest. However, we believe that sufficient information has been obtained from the reports submitted to enable us to go out into the field and sell home lighting to other Hydro municipalities. The results have been encouraging; with fewer handicaps they would have been a lot better; with a little more organization they will improve, and we sincerely hope that in 1937 more municipalities will join in this lighting campaign and put a little more enthusiasm into their efforts and that our results next year will be far in excess of those which we have given above.

Appliance Surveys—Urban and Rural

By P. T. Seibert, Sales Department, H.E.P.C. of Ont.

As in former years a survey has been made of appliances in use by Hydro consumers both urban and rural, and the following tables show to what extent Hydro power is being made use of by its customers.

Table No. 1—Estimated number of major electrical appliances in use among domestic consumers at the end of 1936.

Table No. 2—Comparison by systems of saturation of appliances in use among domestic consumers.

Table No. 3—Number of major electrical appliances in use by rural hamlet consumers.

Table No. 4—Number of major electrical appliances in use by rural farm consumers.

Table No. 5—Comparison of the saturation of appliances used in the homes of rural and urban consumers.

The estimated number of appliances in use among domestic consumers was arrived at by totalling the returns received from about seventy-five per cent. of the municipalities and interpolating from them the number in use by all domestic consumers.

The municipalities do not make a complete survey each year, but by occasional test checks and surveys keep their information fairly accurate. Their yearly reports of appliances in use at the end of the year are therefore as correct as could be expected.

TABLE No. 1

TABLE SHOWING ESTIMATED NUMBER OF MAJOR ELECTRICAL APPLIANCES IN USE AMONG DOMESTIC HYDRO CONSUMERS AT END OF 1936

Appliances	Number	Saturation
ELECTRIC		%
Ranges	134,825	27.66
Hot Plates	75,753	15.54
Washers	211,624	43.42
Vacuum Cleaners	146,560	30.07
Water Heaters (Flat Rate)	38,707	7.94
Water Heaters (Metered)	40,760	8.36
Grates	36,186	7.42
Air Heaters	141,476	29.03
Ironing Machines	9,634	1.98
Irons	457,106	93.78
Refrigerators	69,696	14.29
Toasters	268,382	55.06
Grills	47,608	9.77
Furnace Blowers and Oil Burners	21,781	4.47
Air Conditioners	1,573	.32
Radios	347,348	71.26
Number of Consumers	487,417	.....

The number of appliances in use among hamlet and farm consumers (not including summer consumers) in the rural power districts were interpolated from the results of surveys made this year which covered eighty per cent. of all rural consumers. Since eighty per cent. of all rural consumers were surveyed the results as shown are a fair indication of the appliances in use.

A comparison of Table No. 1 with our report at the end of 1934 is very interesting.

TABLE No. 2

Urban Domestic Consumers

Table Showing Saturation of Major Electrical Appliances in Use by Domestic Consumers at End of 1936 in Each System

APPLIANCES	All Systems	Niagara System	Georgian Bay System	Eastern & Nipissing Systems	Thunder Bay System
Electric	%	%	%	%	%
Ranges	27.66	27.64	17.18	27.93	42.92
Hot Plates	15.54	13.42	27.12	17.45	53.96
Washers	43.42	45.87	35.93	30.98	53.72
Vacuum Cleaners	30.07	32.67	15.06	19.85	38.44
Water Heaters (Flat Rate)	7.94	8.39	2.17	5.97	18.70
Water Heaters (Metered)	8.36	7.19	6.77	14.43	15.72
Grates	7.42	8.48	1.49	3.84	6.51
Air Heaters (Portable)	29.03	30.63	16.38	24.12	32.96
Ironing Machines	1.98	2.18	1.00	1.21	1.89
Irons	93.78	94.47	85.75	91.76	101.39
Refrigerators	14.29	15.99	8.20	8.28	6.09
Toasters	55.06	54.03	53.99	59.31	68.15
Grills	9.77	7.44	13.22	21.08	12.42
Furnace Blowers and Oil Burners	4.47	4.92	2.67	3.02	1.62
Air Conditioners	.32	.31	.17	.46	.39
Radios	71.26	72.68	61.48	66.15	76.75

There are 12,000 new range users which increases the saturation from 26.1 to 27.66 per cent. This large increase is no doubt due to the active campaign carried on by this Commission. Apparently other appliances were also influenced. Washing machine saturation rose from 38.9 to 43.42 per cent. with an increase of 28,000 machines. Vacuum cleaner saturation rose from 28.6 to 30.07 per cent. with an increase of 12,000 cleaners. Flat-rate water heater saturation increased from 6.2 to 7.94 per cent. which is encouraging, but leaves room for continued aggressive activity. Refrigerators show a large increase of 18,000 from 10.9 to 14.29 per cent. saturation.

The increase of 62,000 radios to a saturation of 71.26 per cent. would indicate the possibility of increasing the saturation of many other appliances.

The saturation figures in Table No. 2 apparently show that the Georgian Bay system offers the best sales opportunities in all electrical equipment except washing machines. However, the rates in these municipalities must be taken into consideration. The range saturation in the Georgian Bay system is 17.18 per cent. while the Eastern and Niagara systems are over 27 per cent. Water heater saturation in the Thunder Bay system is 18.7 per cent. while the other systems are less than half that.

Hamlet consumers are usually looked upon as residences only, but Table No. 3 shows that there is a considerable number of appliances in use outside of the home.

TABLE No. 3

R.P.D. HAMLET CONSUMERS

	ALL SYSTEMS		NIAGARA SYSTEM		GEORGIAN BAY SYSTEM		EASTERN SYSTEM	
	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation
IN THE BARN								
ELECTRIC								
Motor	1,058	3.12	789	3.45	51	1.00	218	2.84
Pump	241	.71	186	.82	12	.24	43	.55
Grain Grinder	5	.02	5	.02	.....	.....	.....	.....
Milking Machine	.....	.....	.....	.....	.....	.....	.....	.....
Milk Cooler	.....	.....	.....	.....	.....	.....	.....	.....
Cream Sep rator	8	.03	7	.03	.....	.....	1	.....
Churn	5	.02	5	.02	.....	.....	.....	.....
Incubator	65	.19	60	.26	.....	.....	5	.07
Brooder	24	.07	21	.09	.....	.....	3	.04
Hot Bed	2	.....	2	.01	.....	.....	.....	.....
Water Heater, F.R.	.....	.....	.....	.....	.....	.....	.....	.....
Water Heater, Met.	1	.....	1	.....	.....	.....	.....	.....
Air Compressor	82	.24	76	.33	2	.....	4	.06
Battery Charger	125	.37	90	.39	6	.11	29	.38
Miscellaneous	108	.31	80	.35	10	.19	18	.23
IN THE HOME								
ELECTRIC								
Range	3,641	10.63	2,727	11.94	260	5.06	654	8.54
Hot Plate	7,516	21.19	4,335	18.99	1,000	19.43	2,181	28.51
Washer	13,723	39.61	9,399	41.17	1,261	24.49	3,063	40.04
Vacuum Cleaner	4,009	11.81	2,902	12.71	213	4.14	894	11.69
Water Heater, F.R.	839	2.49	697	3.05	29	.56	113	1.47
Water Heater, Met.	633	1.69	364	1.59	148	2.87	121	1.58
Grates	229	.67	152	.67	18	.36	59	.78
Air Heater Port ble	2,531	7.47	1,744	7.63	121	2.35	666	8.71
Iron	22,606	65.38	15,378	67.35	1,982	38.51	5,246	68.57
Ironer	418	.99	188	.82	182	3.54	48	.63
Toaster	14,510	42.05	9,554	41.84	1,197	23.25	3,759	49.14
Radio	21,161	60.54	13,972	61.19	2,290	44.48	4,899	64.05
Furnace Blower	490	1.44	360	1.58	31	.59	99	1.30
Pump	3,607	10.35	2,423	10.61	371	7.21	813	10.62
Refrigerator	2,903	8.51	2,040	8.93	182	3.54	681	8.90
Sewing Machine	87	.26	87	.38	.....	.....	.....	.....
Miscellaneous	627	1.87	571	2.50	25	.47	31	.41

Comparing Table No. 3 with our 1934 report, each system shows increases in saturation except Georgian Bay. Apparently the new hamlet consumers connected during the past two years on the Georgian Bay system use very few appliances.

Table No. 4, compared with two years ago shows that motor saturation has increased from 18.6 to 19.78 per cent. and similar increases among the other barn appliances. Washers, radios and pumps for sanitary purposes show marked increases also, due no doubt to the encouragement given by this Commis-

TABLE No. 4

R.P.D. FARM CONSUMERS

	ALL SYSTEMS		NIAGARA SYSTEM		GEORGIAN BAY SYSTEM		EASTERN SYSTEM	
	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation	No. of Appliances	Per Cent. of Saturation
IN THE BARN								
ELECTRIC								
Motor	6,650	19.78	5,333	20.28	346	12.96	971	19.14
Pump	5,137	15.41	4,263	16.21	183	6.86	691	13.62
Grain Grinder	1,943	5.75	1,664	6.33	156	5.85	123	2.42
Milking Mach.	950	2.84	669	2.54	15	.59	266	5.25
Milk Cooler	443	1.33	380	1.45	20	.76	43	.84
Cream Separator	2,407	7.13	1,789	6.80	120	4.49	498	9.81
Churn	392	1.14	297	1.13	34	1.27	61	1.19
Incubator	372	1.11	293	1.12	18	.67	61	1.19
Brooder	302	.90	239	.91	15	.59	48	.95
Hot Bed	35	.10	29	.11	2	.08	4	.08
Water Heater, F.R.	71	.21	58	.22	9	.33	4	.08
Water Heater, Met.	20	.06	14	.05	2	.08	4	.08
Air Compressor	64	.20	64	.24	.....	.....	.....	.....
Battery Charger	48	.14	45	.17	.....	.....	3	.05
Miscellaneous	235	.70	203	.77	10	.33	22	.43
IN THE HOME								
ELECTRIC								
Range	6,460	19.37	5,702	21.68	319	11.95	439	8.64
Hot Plate	8,447	24.76	6,445	24.51	687	25.76	1,315	25.91
Washer	21,284	62.96	17,132	65.15	1,442	54.06	2,710	53.39
Vacuum Cleaner	4,722	14.21	4,042	15.37	153	5.76	527	10.38
Water Heater, (Flat Rate)	1,198	3.55	1,053	4.01	93	3.47	52	1.03
Water Heater (Metered)	781	2.19	547	2.08	140	5.25	94	1.85
Grate	294	.89	262	.99	7	.25	25	.49
Air Heater	4,130	12.22	3,292	12.51	271	10.17	567	11.17
Iron	27,758	81.74	21,932	83.40	2,115	79.32	3,711	73.11
Ironer	743	1.86	252	.96	269	10.08	222	4.37
Toaster	18,351	54.19	14,656	55.73	1,295	48.56	2,400	47.28
Radio	23,535	69.06	18,170	69.09	1,910	71.61	3,455	68.08
Furnace Blower	642	1.91	454	1.72	13	.51	175	3.45
Pump	6,194	18.23	5,002	19.02	502	18.81	690	13.59
Refrigerator	2,694	8.09	2,327	8.85	106	3.98	261	5.14
Sewing Machine	70	.22	69	.26	.....	.....	1	.03
Miscellaneous	697	1.93	527	2.00	156	5.84	14	.27

sion in the form of free power for their use.

Table No. 5 shows that hot plates and washing machines have a greater saturation in the farm homes than in the urban homes. All other appliances have a greater saturation in the urban homes, such as,—farm ranges 19.37 per cent., urban ranges, 27.66 per cent., farm vacuum cleaners 14.21 per cent., urban vacuum cleaners 30.07 per cent., farm refrigerators 8.09 per cent., urban refrigerators 14.29 per cent. Farm toasters and radios are not far behind the urban homes and irons

TABLE No. 5

COMPARISON OF APPLIANCES IN USE IN THE HOMES OF RURAL AND URBAN CONSUMERS

	R.P.D. HAMLET		R.P.D. FARM		URBAN	
	No. of Appliances	% of Saturation	No. of Appliances	% of Saturation	No. of Appliances	% of Saturation
ELECTRIC						
Range	3,641	10.63	6,460	19.37	134,825	27.66
Hot Plate	7,516	21.19	8,447	24.76	75,753	15.54
Washer	13,723	39.61	21,284	62.96	211,624	43.42
Vacuum Cleaner	4,009	11.81	4,722	14.21	146,560	30.07
Water Heater (Flat Rate)	839	2.49	1,198	3.55	38,707	7.94
Water Heater (Metered)	633	1.69	781	2.19	40,760	8.36
Grate	229	.67	294	.89	36,186	7.42
Air Heater (Portable)	2,531	7.47	4,130	12.22	141,476	29.03
Refrigerator	2,903	8.51	2,694	8.09	69,696	14.29
Iron	22,606	65.38	27,758	81.74	457,106	93.78
Ironer	418	.99	743	1.86	9,634	1.98
Toaster	14,510	42.05	18,351	54.19	268,382	55.06
Radio	21,161	60.54	23,535	69.06	347,348	71.26
Furnace Blower	490	1.44	642	1.91	21,781	4.47

show a high saturation in all homes.

All of the above tables indicate clearly that with the exception of a few appliances there is still a vast field of prospects for appliance sales and promotional effort should not slow down until 100 per cent. saturation is reached.

The Confessions of an Engineer

By Sir Alexander Gibb, G.B.E., C.B., F.R.S., M. Inst. C.E.

Sir Alexander Gibb was appointed by the Admiralty consulting engineer for the naval base at Singapore. To the public his name became familiar when he was appointed one of the consulting engineers by the Dean and Chapter of St. Paul's in connection with the preservation of the Cathedral. Between 1916 and 1918 he was Chief Engineer of the Ports Construction to the British Armies in France and Belgium. He afterwards became Civil Engineer-in-Chief to the Admiralty and, later, Director-General of Civil Engineering to the Ministry of Transport.

IN what I say to-night, I want to address myself first to the great body of engineers and those connected with engineering, some of whom may be listening to me. I have estimated that upwards of one-seventh of the available working population of our country falls into this category. I want to impress upon them all that we are one great fraternity, and though our objectives may often seem very different—even conflicting and competitive—yet we have a great common interest.

This year I have the high honour to be President of the oldest active engineering institution in the world—the Institution of Civil Engineers. There are now more than a hundred engineering societies and institutions in Great Britain, with a total membership of over 100,000 engineers, most of them having staffs large and small under them—all directed to the scientific pursuit of engineering knowledge and its application for the benefit of mankind. They have all grown from the small seed planted when the Institution of Civil Engineers was founded in 1818.

There is, too, a vast body of engineers spread throughout the Government Departments and local authorities, public utility companies, manufactures; and in the railways, shipping, coal-mining and such activities. And there are the great engineering trade unions who in their way, too, have contributed much to the attainment of high standard of workmanship, which is at once the test and the creed of the real engineer.

Secondly, but more important, I want to talk to the great body of my fellow citizens for whom we engineers work, and who have to put up with us and our doings—who have to live with our creations, and in most cases have to pay for them. I would like to show them what a vital part engineering has played in the whole progress of civilization, and how dependent everything in modern life is on the engineer—from the policies of Governments to the cooking of the daily meal.

The engineer's work has been comprehensively described as the art of directing the great sources of power in Nature for the use and convenience

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of man. The first engineers were, I suppose, the tool and weapon makers of almost prehistoric times—the inventors of the spade, and the axe, and the sling, and so on. And the first great achievements in the engineering history of the world were the discovery of fire and the wheel.

When one tries to name the outstanding achievements of early engineering, the milestones of engineering in the history of material civilization as we know it, it is difficult, if not generally impossible, to fix definite dates, or the individuals responsible—for the germs of most engineering ideas are ancient enough. It is not the design that counts, so much as the method of carrying out the work. It is not the invention, but the exploitation of it. Some of the fundamental facts of engineering appear now so simple, that it is difficult to realize that for so many centuries they were unknown; or if not unknown at least unusable or unworkable.

The Romans were great water supply engineers—their aqueducts are still among the marvels of ancient workmanship. Only the other day when I was in Turkey I saw one still supplying part of the requirements of the ancient city of Byzantium, now known as Istanbul (the old Constantinople). But the Romans dealt with water by gravity. Their water courses contoured the hills; and they crossed valleys by aqueducts, never by a syphon. Who first invented or used the method of syphoning water? It is probable that here, as in so many other cases, it was the material, and not the technical skill, that was at fault. As long as man could not produce water-tight or pressure-resisting pipes, he could not use the syphon.

And at what date, too, was first used that ingenious and simple method of raising water—the water-ram?

Again tunnelling is at least as ancient as Babylon. In those far-off days there was a tunnel driven under the Euphrates. But when the Thames Tunnel was built in 1815, some thousands of years later, the methods of construction were still almost as primitive. It was only the courage and persistence of the two Brunels, father and still more famous son, that brought the work to a successful end. Incidentally, the last of that brilliant engineering family lived into this century, and I started my engineering career as a pupil under him.

It was not until fifty years ago or so that tunnelling became a certain and precise art—simply because of the introduction of mechanical drills, accurate surveying instruments, compressed air, Greathead shields, and the like.

We think that our age is the pioneer of long bridges; but the Romans under Trajan built a bridge across the Danube that was 4,500 feet long.

Every visitor to Delhi knows the famous iron pillar, of a purity and immunity from corrosion that we do not find in iron as we make it now.

Canal locks are mentioned at least 450 years ago—diving suits 700 years ago—air pumps and vacuums 300 years ago. And coal was mined and used in this country a century before English bows and arrows won the battle of Crecy. There were great marvels of engineering in ancient days; but they were unique and generally terribly costly. The toll of life

in the construction of the Pyramids must have been worse than a visitation of the plague.

Generally our ancestors were extraordinarily limited in many directions. I have contemporary newspaper accounts of some of the works of a great-great-grandfather of mine who built much of the Forth and Clyde Canal. One was an aqueduct to carry the 7-foot canal across the River Kelvin, with a length of under 200 feet. The milder descriptions refer to it as "This stupendous work".

Well, the basis of all subsequent engineering was, as I have already said, the discoveries of fire and the wheel. Fire meant immediately cooking, smelting, brick-making, and opened up a thousand possibilities—and from the wheel has developed all land transport, and water and wind power.

Next came the ancient metals, copper and tin; lead and bronze; and then iron, and one might add in importance earthenware and glass—all as you will observe notable because they were means to an end—they widened the scope of engineers by providing the materials for engineering.

It would be tedious to attempt to follow engineering through the ages—for centuries progress was so slow as to be unnoticeable at this distance of time. After the Romans, with their water supply, their domestic heating system, their roads, their development of the arch, there was little achieved for a thousand years. Perhaps the most important work in all these years, at any rate in our own country, was the steady process of land reclamation. It has been perhaps easier than ordinary for us in these last few days to realize that in the time of our ancestors vast areas of now populated Britain were unrelieved swamps.

The age of modern engineering was made possible by the revival of scientific thought in the fifteenth, sixteenth and seventeenth centuries. Newton's law of gravitation; the mariner's compass ascribed—though I do not know if correctly—to the Chinese, but perfected in the sixteenth century; the barometer; the telescope and microscope; the theory of the tides; the thermometer; the sextant and chronometer; and so on.

As science opened the door engineering pushed in. Although I must confess that a good deal of the work of engineers to begin with was guesswork, or as we would now say, empirical. It sounds better.

From the middle of the eighteenth century the pace increases. The great engineering feats at that time were canals and the earliest beginnings of machinery. The year 1776, when Boulton and Watt's factory at Soho near Birmingham turned out the first practical steam engine, and the year 1781 when they perfected it to give rotary action, certainly justify that much abused phrase "epoch-making". Almost simultaneously came the spinning machine, the power loom, and mechanical developments in every direction.

The story of the growth of railways is known to everyone. The first railway actually sanctioned by Parliament was in 1801, but it was not to be operated by locomotive. Trevithick's first locomotive came in 1804 and Stephenson's first locomotive ten years later. The great railway age started in the 'thirties and 'forties,

and my grandfather built the first railway in Scotland and incidentally lost all his money doing so.

It is perhaps not so generally known that in the early days attention was directed more to the production of automatic road transport than rail. But prejudice, vested interests and the greater opportunities for speculative business offered by railway construction combined to postpone for two generations the development of mechanical road transport.

Engineering in those days was a speculative matter, fraught often with financial disaster to those concerned. It could not be otherwise—the implements were inefficient, the materials inadequate, and the instruments inaccurate compared with those of the present day.

Even more revolutionary was the effect of steam on sea transport. For three or four thousand years ships had only been propelled by wind or by hand. This was changed in a decade. The three- and four-decker galleys of the Romans, Greeks, Phoenicians were a marvel—chiefly that they could be manoeuvred at all. Equally marvellous were the sea voyages of the diminutive sailing vessels of the Middle Ages. But it would require a fleet of over 50,000 of the type of ship that plied in and out of our ports in the days of our great-grandfathers, to carry only the exported portion of an average Canadian wheat crop. The Queen Mary is at least double the combined tonnage of all the merchant ships under the British flag a century ago.

Quite as important, too, in effect on engineering were the developments of the manufacture of steel and of modern Portland cement. The former affected machinery in every way and form, and both have entirely revolutionized the whole of structural and architectural engineering.

But it would be a big task to name all the great inventions of the nineteenth century. Simply to give some idea of comparative dates, I might mention the use of gas as an illuminant (1792) and later for heating; the electric battery (1790); the telegraph (1838) and the telephone (1876); the Atlantic submarine cable (1858). The electric arc light came into use about the middle of last century. My father was actually the first to employ it for lighting by night on construction works, and the installation was put in by a young engineer, now the G.O.M. of electrical engineering—Colonel Crompton, a great inventor and a wonderful old man.

And so was ushered in the age of our own generation—surely the most wonderful period in the world's history—an age primarily of electricity and the internal-combustion engine. The material progress of the world in these last forty years or so has exceeded all that was attained in the four thousand years before. Just compare what life was like in 1890, when I started engineering, and now. The bicycle, the motor car, the aeroplane, wireless, gramophones, cinemas, television, the submarine, domestic plumbing, water supply, sanitation, cold storage and food preserving, tinned goods, artificial silk, the development of rubber, artificial fertilizers, aluminium, reinforced concrete, steel alloys: the list is endless. The whole outlook and means of life have been completely changed.

When I first employed a German land dredger and automatic concrete mixers over here on some work I was carrying out, my father thought I had taken leave of my senses. If he used concrete at all—which he greatly disliked and did not altogether trust—it would all be mixed by hand. An up-to-date excavator will now take out twenty tons of earth at a scoop and do the work of hundreds of men.

Nowadays, you have fruit all the year round. A peach in winter is far cheaper and just as good as those that used in former days to appear for a few weeks in summer—far beyond the purse of many of us, especially myself.

In health or illness, work or sport, within less than a full generation the world has been changed out of all recognition. We work now for two things—mechanization and speed. There were four motor cars in the United States of America in 1895. There are now something like thirty million. We have multiplied by ten times the distance an individual can easily travel in his own conveyance on the ground in a day—and by fifty times if he takes to the air.

And at the same time engineering has made out of date almost every road in the world. All of our 178,000 miles of road in this country have had to be re-made because of the motor-car—and still they are not adequate—only rendered even partially safe by restrictions that can only be looked on as temporary.

The development of the internal combustion engine, has, incidentally, created an enormous oil industry, so far-reaching, so vital and so powerful, that the various great oil interests rank practically as a major nation in the international politics of the world—and the subject is as vital to any nation as its food supply.

Similarly the demand for electricity has led to the use of a new form of power developed from water. Hydro-electricity is already developed to a capacity of over thirty million horse-power. Even this is only a small portion—perhaps a seventh or tenth—of the world's water power resources, although in fact it may be taken as pretty certain that a great part of those resources are not likely to be ever developed. The obvious result of this has been, for the time at least, to change entirely the outlook, position and politics of countries deficient in coal resources but possessing plenty of water power, such as Norway, Italy, Canada and Ireland.

The telegraph, and, still more, wireless telegraph, are another obvious form "speed"—too obvious, like the aeroplane, for it to be necessary to mention them. Although so very recent, they are already ignored as a commonplace. Anyone of my age will remember that the arrival of a telegram used to be considered as inevitably meaning bad news; no one—at least in Scotland—would have spent sixpence for any other reason.

I am not going to describe modern life to you; you know far more about it than I do. But do sometimes think of the changes that have so rapidly overtaken us in our various walks of life—big and small. Not only the great inventions but the minor, almost trivial, innovations too—typewriters, fountain pens, patent lighters, neon lighting, traffic signals, the Tote and the thousand more commonplaces of everyday life. How remarkably in-

genious they are. What a difference they make; and yet they are no longer thought of as inventions.

Never was progress—if we may call it progress—at any rate, never was change so continual and so rapid. There is no doubt science and engineering have gone ahead so fast that we are all rather out of breath.

At the outset, I referred to the very large number of our population who are engineers or connected with engineering. You may have thought I was drawing the long bow. But by now you will probably feel I understated the position. And if everyone listening now feels that he or she is an engineer, so much the better.

But you will probably want to know something of the principal recognized divisions of engineering. I think one might say that there are eight principal classes: civil (including structural); mechanical; electrical; chemical; metallurgical; marine (including naval architects); mining; gas.

I am dealing with engineering and not architecture, but architects are so closely connected with engineering that I cannot omit mention of them. Though not engineers, they are certainly our first cousins!

In its inception the term "civil engineer" meant the engineering of civilization—all in fact except the purely military engineer. But in time it has obtained also a more restrictive sense. The Institution of Civil Engineers still stands for the widest interpretation, but the so-called civil engineer specializes in the construction of roads, railways, bridges, canals, ports, harbours, sea-works, river training, dams, irrigation, water supply, tunnelling, earth removal, foundations, and all types of structural work.

The mechanical engineer is primarily concerned with machinery and engines, the production and use of power.

The electrical engineer deals with the production and many applications of electricity—lighting, power, telegraphy, wireless, electro-chemistry and so forth.

The chemical engineer, a much more recent development, has to do with the large-scale handling of materials in manufacture. Obviously to a large extent he deals with the design and erection of plant for the manufacture of chemical products, alkalis, acids, dyes and so on: but he is equally concerned in the methods of manufacture of food products, oil refining and artificial silk.

The metallurgical engineer's business is sufficiently obvious—as is that of the mining engineer. The work of the gas engineer is generally considered as restricted practically to the manufacture and distribution of coal gas for lighting and heating, and the utilization of the by-products, coke, tar, ammonia, etc. The marine engineer deals with the mechanical side of shipbuilding, and the naval architect with the structural.

No hard and fast rule, however, divides one class from another. They are all engineers, and their fields necessarily overlap. The needs of an age of specialisation has led to the creation of bodies to look more closely after the special interests of those who are dealing with some particular form of engineering. And division and sub-classification have gone very much further. There are railway engineers, locomotive engineers, per-

manent way engineers, structural engineers, reinforced concrete engineers, fuel engineers, maintenance engineers, inspecting engineers—and a hundred more—each class generally having its own special institution or society, its own proceedings or journal. Most engineers, in fact, belong to several. I think I have the privilege of paying subscriptions of twelve technical institutions.

And here I would like to refer again to what I have often mentioned on other occasions, the great need for co-operation among engineers. Devolution and specialization have gone far enough. As we look forward, we see inevitably an increasing concentration of ultimate state control over all our activities, and the general nationalization of effort. It is so, whatever our individual views may be. And therefore, both from the point of view of the country and of the engineer, it is essential that the ranks of engineering should draw together, that they should co-operate in their research, in the interchange of knowledge and in their activities.

The question of research is particularly important and difficult. It is becoming increasingly necessary and increasingly costly; the securing of funds for it is a constant problem. There should therefore be no overlapping if it can be avoided.

Greater co-operation will, too, the better serve to maintain the high standard of engineering. It will enable us with all propriety to influence Governments in matters that affect engineering; to secure the best forms of education and training; to protect at once both their own power, interests, and the interests of all whom they serve.

For it is impossible to over-estimate the importance of maintaining the highest standards, both technical and ethical, in engineering. The engineer is the servant and builder of civilization. In a narrower sense he has been the creator of our Empire. In him to a great extent rests the future of our country and our civilization.

Now some who are listening to me are perhaps parents with sons—and daughters—whose careers have yet to be decided, or young men considering now their future. I would like to say a few words to them on engineering as a career. Technical aptitude and a scientific—or at least a logical—outlook are very advisable, if you are going to adopt engineering as a profession. These qualities do not always go hand-in-hand with commercial acumen. It would be much better for the engineer if they did. I shall not be misunderstood when I say that the average engineer is often, perhaps inevitably, more interested in the technical than in the financial aspects of his work. It is well—in fact, it is essential—that a workman should have a pride in his work. But there is an economic side to engineering which must not be overlooked.

You probably all know the old definition of an engineer—that he is a man who can do for one dollar what any darned fool can do for two dollars. There is a lot of truth in that. I used to know well an old and very successful civil engineer who maintained that good engineering was one part technical ability and three parts

commonsense, and—he used to add—most of the engineers he knew had the technical ability all right.

As one looks around in this new world it is unfortunately the fact that one is often appalled at the fearful waste of money that has at times taken place—entirely unnecessarily—in different forms of engineering—the millions spent on ineffective river draining, ports that have silted up before their construction was finished, railways that have been too costly ever to pay, factories that have been doomed to failure before they started, a thousand-and-one inventions that were never worth development. Every engineer should make it his duty to see that not a penny too much is spent on any work that he is responsible for. If you must experiment, do not do it with someone else's money. By directing his attention to the commonsense or the economic side of his work, as well as the technical, the engineer will be benefiting himself, his profession and his country.

On the whole engineers do not make big money. I would not, for instance, advise a young man to enter the ranks of consulting engineers if his main object is to make a fortune. But then probably that is not the real object of most of us, though we toy sometimes with the idea; and in any case I do not know many walks of life where fortunes are easily to be picked up.

Engineering, on the other hand, is a profoundly interesting profession. It appeals to the intelligent and active mind. There are always new problems—and new opportunities for the use of one's brains. The dependence of the world on engineering must always be increasing, and though we have been through bad times, on the whole I would the more confidently recommend a young man to take up engineering than any other profession—always provided he has the aptitude. Generally speaking, I would not call it over-crowded. There is always work for the really good engineer; it is, I should say, very seldom that there is not a position for even a second-class man in engineering, if he is steady and conscientious. That is more than is to be said of all professions.

But it is a fairly long training and whether a young man has gone through school and university and got a degree, or is starting to work through shops, he will need years of practical training or apprenticeship before he will be justified in thinking of himself as an engineer.

So far as girls are concerned, although I know some lady engineers, it is not a profession I would recommend them to adopt, unless there are special reasons, and assured positions waiting for them. It is not that I would not wish to see their numbers in the ranks of engineers increase, but the trail has yet to be blazed, and I fear there may be difficulties and disappointments in store for the pioneers.

I fear that it is time that I drew my remarks to a close, I am afraid that I have not given you any of the confessions that you perhaps expected. It seemed to me too important an occasion for me to waste with my own frivolous experiences. I have not tried to put before you any striking views, or new theories. It is obvious-

ly so much more easy for Mr. H. G. Wells with his fertile imagination to portray the future than for one like myself, only trained to devise what is capable of practical realization. But even the sober engineer can foresee some very striking developments in the comparatively near future. Within ten years or so, we shall have stratosphere flying, speeds of five or six hundred miles an hour, week-end trips to India; we shall have complete automatic wireless control of aeroplanes in all the main aerodromes; we shall have similar wireless navigation of ships into harbours, and shall have developed an infra-red "eye" to enable direct sight through fog and mist. We shall have perfected wireless to an extent when the overcrowding of the ether will no longer be a problem, and we shall in time have an inter-office and inter-business private wireless telephone communication. Freight aeroplanes will be a commonplace. I anticipate a considerable revival in the use—rather than the present abuse—of coal, and great changes in metallurgical developments. The extension of welding will affect all structural work and incidentally eliminate the deafening racket of riveting. The elimination of noise will be one of the main objectives of engineering; and the pneumatic drill will disappear, as well as the present method of pile-driving. Air conditioning, the ventilation of buildings and the provision of perfect acoustics, will all be very advanced. The problem of electrical storage should be solved. The use of solar power and the latent heat in the interior of the earth are developments I anticipate confidently, but necessarily further off. There is no doubt a vast field is already opening in the development of rays—ultra-violet, infra-red; and I think the engineer must be affected ultimately by the achievements of the scientist in his investigations into the atom. Synthetic materials obviously will develop very greatly. The use of transparent paper for food packing will become almost universal—and probably be of a quite ephemeral and perishable nature, so that it will not remain to encumber the earth after its legitimate use. Another development I confidently anticipate is a practical method of de-salinification of sea water. Geophysical surveying and echo sounding will revolutionize mineral prospecting and hydro-graphic work.

There are many other matters I might refer to—motor roads and stream-lined trains and the immense field of chemical engineering. Engineering is in fact so rapidly overcoming the obstacles of nature and human failings that soon the difficulty will be to retain any scope for personality and individuality either in work or play. Already we see our games being so mechanized and perfected, that it is necessary to restrict the manufacturers' skill—witness, for instance, the golf ball. Where will it end? A mechanical cricket ball could easily be devised that would solve the problems of our Test Match selectors. But I am trespassing on Mr. Wells' ground.

The fact remains that the resources of nature are still scarcely tapped. They are almost immeasurably immense. Why the whole population of

the world could find standing room in the Isle of Wight, though it might tax even the engineer to keep the peace, and the island would probably submerge under the heavy responsibility.

When one hears prophecies of ultimate world food shortage—exhaustion of our oil resources and the like; the answer is that there are many other means than those we now know for the production of foodstuffs and heat and light and power.

It is some consolation to know that the world can never get on without engineers.—*The Listener.*

Albert Roberts, St. Thomas

Albert Roberts.

Stricken with a heart attack at his home, late on Saturday morning, July 10, 1937, Albert Roberts, chairman of the St. Thomas Public Utilities Commission, died in the Memorial Hospital, St. Thomas, about an hour later.

Mr. Roberts was born in Fullerton, Perth County, 67 years ago, coming to St. Thomas with his parents in boyhood. With the exception of a few years spent in Chicago, Ill., and Mitchell, Ont., he lived ever since in St. Thomas. He first took up merchant tailoring which trade he followed for many years. Subsequently he took a position with the Hydro-Electric Power Commission and was stationed at St. Thomas high tension station. Following that he went into the insurance business.

His first interest was in the city and the city's services. Prior to the formation of the Public Utilities Commission in 1935, of which Mr. Roberts was chairman, he served for 16 years on the city water commission. He was also a member of the Board of Education. Being a man of progressive ideas, who thought in advance of the other fellow, he was responsible for many improvements in the departments in which he served.

Surviving Mr. Roberts are his widow and three daughters, and also two brothers and three sisters, to whom we extend our sympathy.

Guglielmo Marconi

BY the death on Tuesday, July 20th, of Guglielmo Marconi the world has lost one whose pioneering work in radio development has profoundly influenced civilization.

Marconi was born on April 25th, 1874, at Bologna. His father was an Italian, his mother a daughter of Mr. A. Jameson, of Wexford; to her he owed the encouragement that stimulated his youthful efforts. He was educated at Leghorn and at Bologna University. Early experiments in the application of Hertzian waves to the transmission of signals were conducted at his father's country house at Pontecchio, when he discovered that the use of relatively tall aerials in conjunction with earth connections affected a fundamental improvement. For detection he used the Branly and Lodge coherer, which he adapted.

In 1896 Marconi came to England. The main features of his investigations up to that time were described in a letter, dated November 14th, 1896, which he wrote to Sir William Preece, engineer-in-chief of the British Post Office. Sir William was at once interested and provided facilities for carrying out tests.

In the same year Marconi took out the first patent ever granted for wireless telegraphy based on the use of electric waves, giving demonstrations before officials of the Post Office and other representatives of British and foreign government departments of transmissions up to

The late Marchese Marconi.

nine miles. In June, 1897, he went to Spezia at the invitation of the Italian Government and established communication with warships up to a distance of twelve miles.

A company was formed in London in July, 1897, to acquire the Marconi patents in all countries except Italy, and in the following year wireless telegraphy was first used for commercial purposes, when the Kingstown Regatta races were reported by means of apparatus installed on a tug. Wireless apparatus was also installed on the East Goodwin lightship for communicating with the South Foreland lighthouse twelve miles away. The first communication between England and France (South Foreland to Wimereux) followed in the next year, when wireless was used also in naval manoeuvres over distances of seventy-four miles, coupling being introduced between the aerial and detector circuits.

In 1900 a patent was taken out (No. 7777) for "tuned or syntonic telegraphy", by which time signals had been transmitted to points more than 200 miles distant, supporting Marconi's view (contrary to that held by many) that the curvature of the earth's surface would not prove to be a bar to long-range working. These results led Marconi to erect a station at Poldhu, Cornwall, from which he reported receiving signals at St. John's, Newfoundland, 1,800 miles away, on December 12th, 1901, and some months later readable messages on a liner at distances up to 2,000 miles.

A practical form of magnetic detector was substituted for the coherer in 1902 and the horizontal directional aerial was patented in 1905. These were used in the station at Clifden in Ireland, which was put into commission in 1907, and which enabled Marconi, with the assistance of Mr. H. J. Round, to transmit signals to Buenos Aires in 1910. Two years later Marconi devised the "timed-spark" system of generating continuous waves, by means of which the first messages were sent from England to Australia on September 22nd, 1918.

Simultaneously, from 1916 onwards, Marconi had been interesting himself in Italy in the potentialities of very short waves—a subject in which he showed the keenest interest right up to the last. These investigations were made practicable by the invention of the thermionic valve by Sir J. A. Fleming (who had described it in 1904). Later in England, with the assistance of Mr. C. S. Franklin, Marconi transmitted very short waves over increasing distances and also at increasing frequencies with a view to lessening the effect of daylight. The result was the establishment of short-wave beam stations throughout the Empire.

Honours were conferred on him in many lands. In Italy, among numerous other distinctions, he received the hereditary title of Marchese in 1929. In Britain he received the Grand Cross of the Victorian Order, honorary degrees from the principal universities, the Nobel Prize for Physics, the Albert Medal of the Royal Society of Arts and the Rectorship of St. Andrews. He was elected, in 1926, an honorary member of the Institution of Electrical Engineers, of which he was a member for thirty-nine years and an ordinary Member of Council for a period, and he was a recipient of the Kelvin Medal.—*Electrical Review.*

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Use of Hydro Shows Steady Growth

Consumption and Revenue of Domestic, Commercial and Rural Services Among Hydro Consumers for 1936 Compared with Former Years

G. J. Mickler, B.A.Sc., Sales Department, H.E.P.C. of Ont.

ONCE more the growth in the use of Hydro service by domestic and commercial consumers served by the Hydro-Electric Power Commission shows a comfortable increase. During the year 1936 the increase is substantially greater than that noticed in the year 1935 or 1934, and it would appear from the tables of revenue and consumption which are submitted herewith that there is a gradual increase in the rate of use by both classes of consumers, due in part to the activities of the Commission in promoting the use of electric ranges, water heaters and better lighting, and also to the fact that employment conditions generally have improved and the buying power of Hydro consumers has increased to permit the purchase and use of more electrical appliances and more lighting equipment.

As in former years, tables are submitted herewith to show the growth in revenue and consumption from year to year since the inception of Hydro service.

Growth of Domestic Use

Table No. I. gives data for domestic consumers in cities of over 10,000 population, showing the annual revenue, consumption, number of consumers, average cost per kilowatt-hour, as well as the average monthly bill and the average monthly consumption.

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Vol. XXIV. No. 9
SEPTEMBER, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication

A study of this table will show that there has been a steady increase in both revenue and consumption since the year 1932. Part of the increase in 1936, however, is due to the fact that statistics for the city of Sudbury were included in the 1936 figures and not in those of previous years. This accounts for the increase in the number of consumers served. It is interesting to note the increase in the average monthly bill and in the average kilowatt-hour consumption per month during the past year.

Another reason for the increase in revenue and consumption among cities is that during 1936 the amalgamation of four Border Cities municipalities was consummated and the statistics for Sandwich and Walkerville were combined with those of Windsor, whereas in the year 1935 they were included in the figures of municipalities under 10,000 population.

Table No. II. gives similar data for domestic consumers in towns of over 2,000 population, and if we eliminate the effect of the amalgamation of Walkerville and Sandwich with Windsor the consumption and revenue for 1936 shows a substantial

TABLE NO. I.
Data for Cities over 10,000 Population
DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	12	$ 614,925.00	12,646,400	55,597	4.86¢	$1.06	21.8
1917	19	1,063,264.00	36,693,100	107,248	2.89	.88	30.5
1920	21	1,926,924.00	84,328,000	154,186	2.29	1.11	48.4
1923	21	3,772,416.00	206,266,200	223,028	1.83	1.53	83.5
1926	21	5,374,069.00	324,290,285	255,109	1.66	1.80	108.0
1929	26	7,530,748.75	497,102,897	309,645	1.51	2.08	137.2
1932	26	8,491,082.70	593,618,860	323,844	1.43	2.18	152.8
1935	26	9,096,420.26	664,178,767	335,467	1.37	2.26	165.0
1936	26	9,743,001.62	720,002,863	350,083	1.35	2.32	171.4

TABLE NO. II.
Data for Towns over 2,000 Population

DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	19	$ 90,330.00	1,414,500	7,410	6.38¢	$1.11	17.4
1917	27	180,075.00	3,824,600	15,731	4.71	1.01	21.4
1920	36	353,915.00	10,053,100	24,041	3.50	1.26	36.0
1923	43	651,499.00	25,411,300	34,135	2.56	1.57	60.1
1926	48	1,037,016.00	50,487,035	47,873	2.05	1.84	89.6
1929	54	1,474,547.24	68,283,456	57,699	2.16	2.11	97.8
1932	59	1,595,906.55	81,054,613	62,843	1.97	2.11	107.5
1935	61	1,653,183.06	88,554,262	66,495	1.87	2.07	111.0
1936	57	1,460,916.64	80,678,385	61,102	1.81	1.99	110.1

TABLE NO. III.
Data for Villages under 2,000 Population

DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	18	$ 24,913.00	291,000	1,859	8.55¢	1.10	13.1
1917	77	97,516.00	1,412,500	8,334	6.90	.96	14.0
1920	109	233,819.00	3,829,900	15,665	6.00	1.29	21.2
1923	142	531,505.00	11,249,100	29,689	4.72	1.59	33.7
1926	174	942,309.00	29,945,632	46,900	3.15	1.71	54.4
1929	193	1,251,564.03	46,755,369	57,075	2.68	1.80	67.2
1932	213	1,589,233.10	66,226,945	65,928	2.40	2.01	83.7
1935	215	1,643,932.71	74,239,844	69,303	2.21	1.98	89.3
1936	219	1,718,548.21	81,291,076	71,372	2.11	2.01	94.9

TABLE NO. IV.
All Municipalities Totalled

DOMESTIC SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	49	$ 730,168.00	14,359,100	64,866	5.08¢	$1.06	21.0
1917	123	1,340,855.00	41,930,200	131,313	3.20	.91	28.6
1920	166	2,514,658.00	98,211,000	193.892	2.56	1.15	44.6
1923	206	4,955,420.00	242,926,600	286,852	2.04	1.54	75.7
1926	243	7,353,394.00	404,722,959	349,882	1.81	1.79	98.4
1929	273	10,256,860.02	612,141,722	424,419	1.67	2.05	122.5
1932	298	11,676,222.35	740,900,418	452,615	1.57	2.15	136.4
1935	302	12,393,536.03	826,972,873	471,265	1.50	2.19	146.2
1936	302	12,922,466.47	881,972,324	482,557	1.47	2.23	152.3

increase over the previous year for all customers in this class.

Table No. III. shows the growth in villages of under 2,000 population. Here again there is an increase in revenue and consumption and a very satisfactory increase in the average monthly consumption.

Table No. IV. summarizes the results for domestic consumers in all municipalities, and an examination of the figures reveals a substantial increase in revenue and consumption even after the effect of the addition of Sudbury has been taken into account. It will be observed that the average cost per kilowatt-hour is now down to 1.47c, and the average monthly consumption has risen to 152.3 kw-hr.

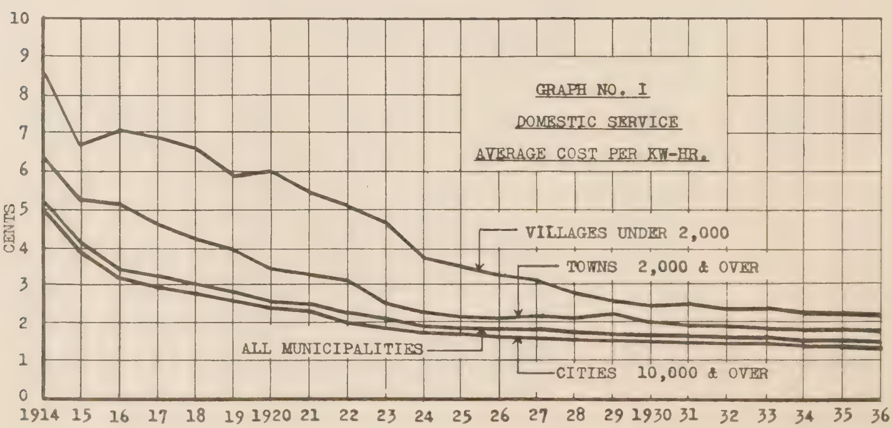
While the growth in the use of electricity among consumers has been steadily increasing we are yet a long way from the saturation point. It is estimated that the average domestic user should consume from 600 to 800 kilowatt-hours per month. In other words, the average householder has need for equipment which will use that amount of electricity. It is true that other forms of cooking, water heating and so forth may be preferred by consumers to the electrical way and that there are many consumers who will never make use of Hydro for these purposes, nevertheless, there is the possibility that they will and if sales efforts are continued a great many of present non-users will undoubtedly become users in the near future, so that there is a prospect that part at least of the ideal consumption will be revealed in the tables in years to come. The fact is that domestic use is less than 25 per cent. saturated.

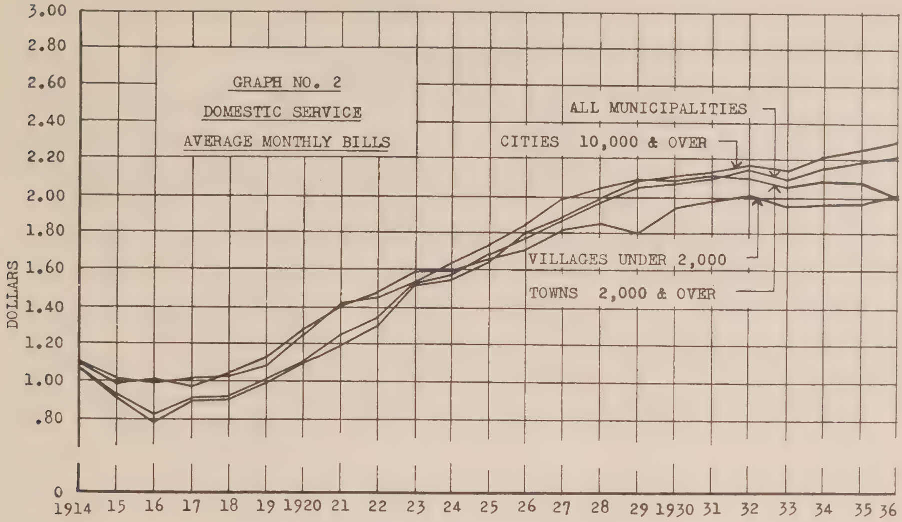
The growth in the use of Hydro by domestic consumers is further illustrated by graphs.

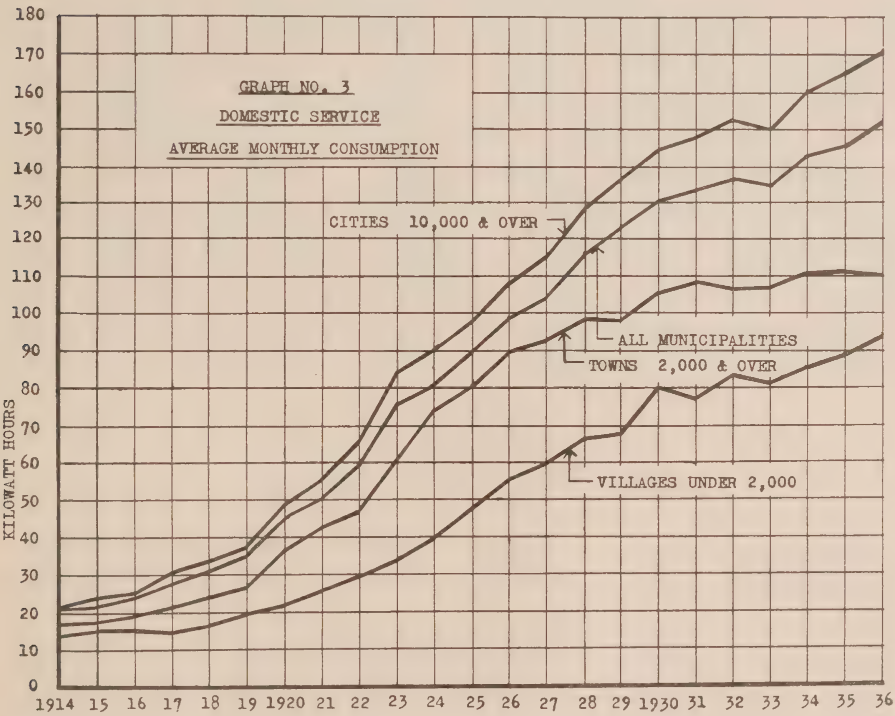
Graph No. 1 shows the average cost per kilowatt-hour for each of the four groups of municipalities included in Tables Nos. I, II, III and IV.

Graph No. 2 shows the gradual growth in the average monthly bill among the same groups of domestic consumers.

Graph No. 3 shows the growth in the average monthly consumption among the same groups of domestic consumers.







In comparison to the results shown by these tables and graphs it may be interesting to give a few figures on the average consumption and the average cost per kilowatt-hour in the United States. A recent survey made by a prominent authority in the United States showed that the

average consumption per domestic consumer is less than 800 kilowatt-hours per year, or less than 65 kilowatt-hours per month. Compare this with an average of 152 kilowatt-hours per month in Ontario. The average cost of domestic service in the United States is approximately 4.9c per kilowatt-hour compared to an average cost of 1.47c in Ontario. The United States consumer pays over 3 times as much for electric service as Hydro customers do. The average bill is approximately $3.00 per month and comparing this with the average monthly bill of a Hydro consumer, $2.23, a Hydro consumer receives 2½ times the energy consumed by his neighbour to the south for ¾ of the cost.

GROWTH OF COMMERCIAL USE

In the tables of revenue and consumption for commercial consumers in Ontario submitted below, it would appear that the effect of the slowing down of industry and the depression generally during the past few years is gradually wearing off and that normal increases in use of Hydro for industrial and commercial purposes is being restored.

In Table No. V. are submitted data for cities of over 10,000 population, showing the annual revenue, annual consumption, number of consumers and so forth. In this table it will be seen that there is a very marked increase in the annual revenue and the annual consumption among this class of commercial consumer. Part of this increase, of course, is caused by the addition of Sudbury figures to those of the other municipalities, Sudbury not being included in 1935 statistics. Then again, the amalgamation of the Border Cities also had its effect, but reduction in the average cost per kilowatt-hour and the increase in the average monthly consumption and the average monthly bill were not affected by these conditions.

Table No. VI. shows the growth in towns of over 2,000 population. An examination of this table shows that there has been a reduction in the number of municipalities served and a reduction in the revenue and only

TABLE NO. V.
Data for Cities over 10,000 Population
COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	12	$ 536,350.00	14,048,500	12,439	3.80¢	$3.94	103.7
1917	19	642,989.00	27,479,800	19.573	2.34	2.96	126.6
1920	21	1,103,599.00	50,358,000	25,505	2.19	3.77	172.0
1923	21	2,043,197.00	91,146,500	32,016	2.25	5.56	246.9
1926	21	3,393,186.00	147,581,714	40,675	2.30	7.08	308.0
1929	26	4,772,209.30	230,263,364	48,713	2.07	8.49	401.5
1932	26	5,088,113.49	254,512,316	51,753	2.00	8.19	409.8
1935	26	5,286,039.72	273,302,264	50,835	1.93	8.66	448.0
1936	26	5,673,317.44	298,250,755	52,058	1.90	9.08	477.4

TABLE NO. VI.

Data for Towns over 2,000 Population
COMMERCIAL SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	17	$ 71,457.00	1,362,000	2,393	5.25¢	$2.61	49.8
1917	27	134,730.00	3,100,600	4,107	4.35	2.76	63.5
1920	36	221,867.00	6,179,400	5,736	3.59	3.30	91.8
1923	43	315,530.00	9,598,000	7,086	3.29	3.76	114.3
1926	48	430,467.00	15,709,616	8,310	2.74	4.31	160.0
1929	54	632,010.30	26,240,436	10,214	2.41	5.13	213.1
1932	59	723,774.94	31,786,728	11,359	2.28	5.31	233.2
1935	61	717,248.27	32,555,348	11,310	2.20	5.28	239.9
1936	57	687,355.93	32,957,583	10,600	2.09	5.40	259.1

TABLE NO. VII.

Data for Villages under 2,000 Population
COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	14	$ 16,974.00	259,200	825	6.55¢	$1.74	26.6
1917	77	82,756.00	1,403,100	3,773	5.86	1.87	31.7
1920	109	152,497.00	2,799,500	5,255	5.89	2.45	45.0
1923	142	254,530.00	4,738,100	7,281	4.80	2.96	55.1
1926	173	352,942.00	8,505,684	9,459	4.15	3.22	77.7
1929	193	488,997.65	15,839,530	11,179	3.08	3.70	119.9
1932	213	590,994.43	20,297,499	12,593	2.91	3.91	134.3
1935	215	598,173.03	21,555,809	12,739	2.77	3.91	141.0
1936	219	641,220.20	24,027,215	13,220	2.67	4.04	151.5

TABLE NO. VIII.

All Municipalities Totalled
COMMERCIAL LIGHTING SERVICE

Year	No. of Munici-palities	Annual Revenue	Kilowatt-hours Consumed	Number of Con-sumers	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1914	43	$ 624,781.00	15,669,700	15,657	4.00¢	$3.63	90.8
1917	123	860,475.00	31,983,500	27,453	2.69	2.77	103.1
1920	166	1,477,963.00	59,336,900	36,496	2.50	3.51	140.0
1923	206	2,613,257.00	105,482,600	46,383	2.46	4.80	195.6
1926	242	4,176,595.00	171,797,014	58,444	2.43	6.08	250.0
1929	273	5,893,217.25	272,343,330	70,106	2.16	7.11	328.6
1932	298	6,402,882.86	306,596,543	75,705	2.09	7.05	337.5
1935	302	6,601,461.02	327,413,421	74,884	2.02	7.35	364.3
1936	302	7,001,893.57	355,235,553	75,878	1.97	7.69	390.1

a slight increase in the consumption. This is due to the amalgamation of the Border Cities and the transferring of figures from one table to the other. It is interesting to note the decrease in the average cost per kilowatt-hour and the increase in the monthly bill as well as the monthly consumption, the latter being close to 10 per cent.

Table No. VII. gives data for villages under 2,000 population. Here again, there is quite an increase in the revenue and in the consumption with a corresponding decrease in the average cost per kilowatt-hour with an increased average monthly bill and increased average monthly consumption.

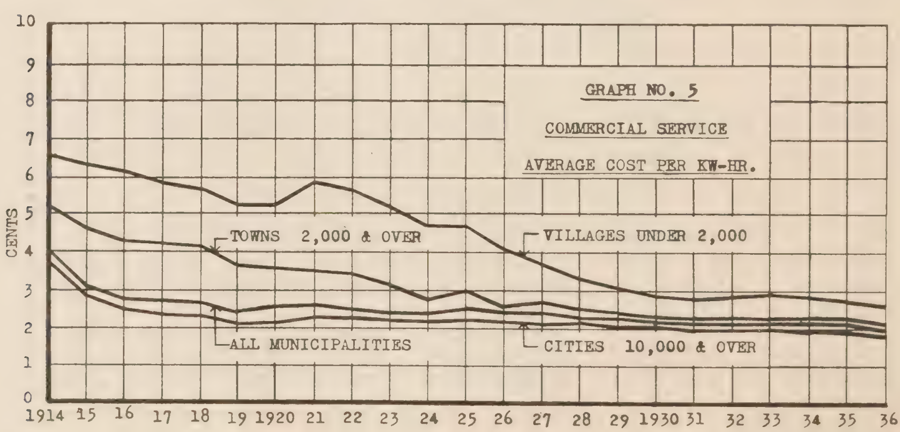
Table No. VIII. summarizes the figures of the Tables V, VI and VII and here it will be noted that there is a very substantial increase in revenue and in the consumption as well as the average monthly bill and the average monthly consumption and the average cost per kilowatt-hour keeps coming down.

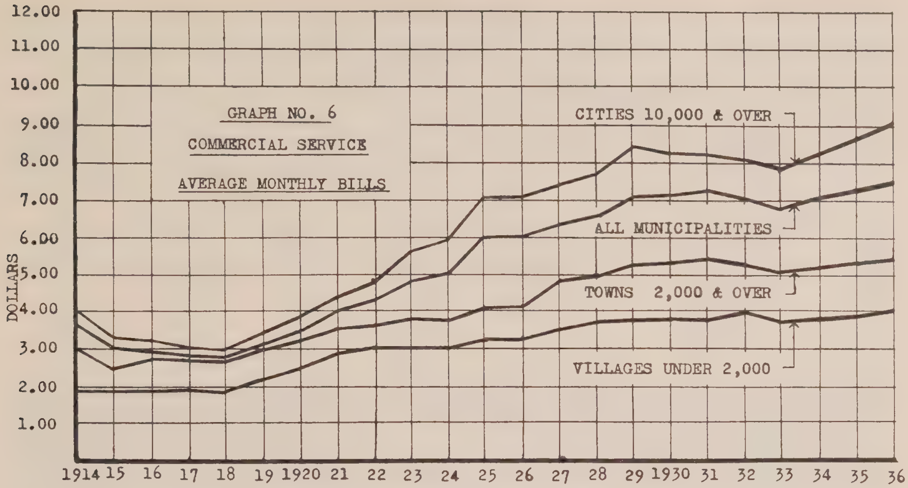
The figures on commercial lighting contained in Tables Nos. V, VI, VII and VIII are also graphically illustrated in Graphs Nos. 5, 6 and 7.

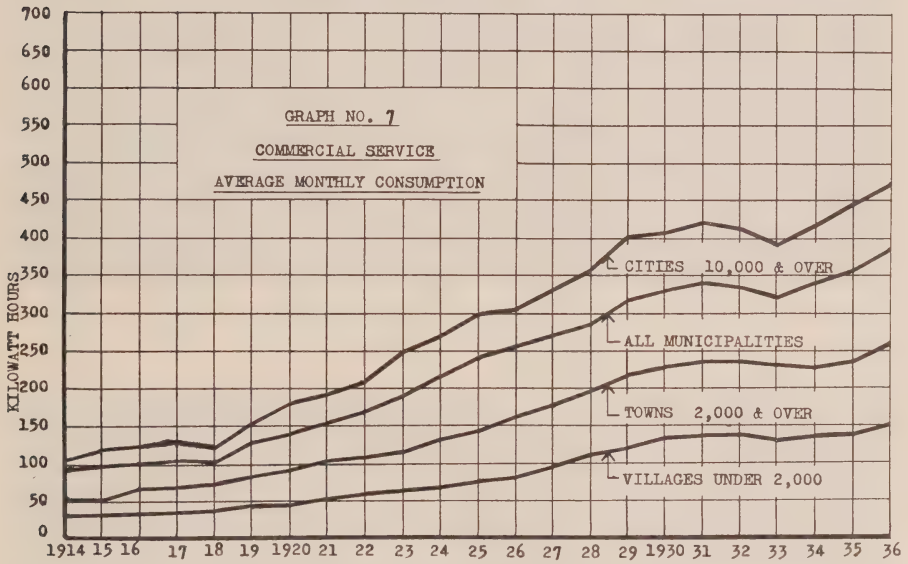
There is no way in which an estimate of the ultimate use of electricity by commercial consumers can be determined, because of the classes of consumers served and the multitude of uses to which these consumers put electric service. There is ample evidence that with the increased use of electricity for commercial cooking, commercial and industrial lighting and for other purposes that there will continue to be a steady increase in the use of electricity by commercial customers.

Gradually the storekeeper is coming to realize the advantages of proper illumination for show windows and his store interior; competition is forcing him to use more light to properly display and sell his merchandise.

The factory owner is commencing to realize the advantages to himself and to his employees of improved lighting conditions in his factory, and other commercial consumers are learning from day to day the advantages of electrifying cooking and heating processes and all of these developments are reflected in an increase in consumption from year to







year, and the future may show some very interesting figures as a result.

Growth of Rural Use

In Table No. IX. are shown the statistics for hamlet consumers in Hydro Rural Power Districts. Up to this year no information has been published on the growth of service in rural communities, but sufficient information has now been accumulated to show comparative data for several years back. The figures in this table in some respects might be compared with the data for villages under 2,000 population, as revealed in Table No. III to get some idea of the relative monthly consumption and the average monthly bill, as well as the average cost per kilowatt-hour.

TABLE NO. IX.
Data for Rural Power Districts
HAMLET SERVICE

Year	Annual Revenue	Kilowatt-hours Consumed	Number of Consumers Billed *	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1928	$ 530,407.00	10,702,031	17,585	4.95¢	$2.51	50.7
1929	663,311.00	14,424,770	21,219	4.60	2.85	62.0
1930	757,558.00	17,815,987	25,013	4.25	2.73	64.2
1931	974,224.17	22,127,474	31,176	4.40	2.88	65.6
1932	1,075,081.03	24,654,386	33,638	4.36	2.76	63.3
1933	1,133 368.70	25,410,470	35,941	4.46	2.70	60.1
1934	1,149,876.67	27,768,460	37,466	4.14	2.61	63.0
1935	1,171,873.28	30,802,290	39,751	3.80	2.53	66.5
1936	1,239,010.83	35,666,241	43,014	3.47	2.49	71.8

TABLE NO. X.
Data for Rural Power Districts
FARM SERVICE

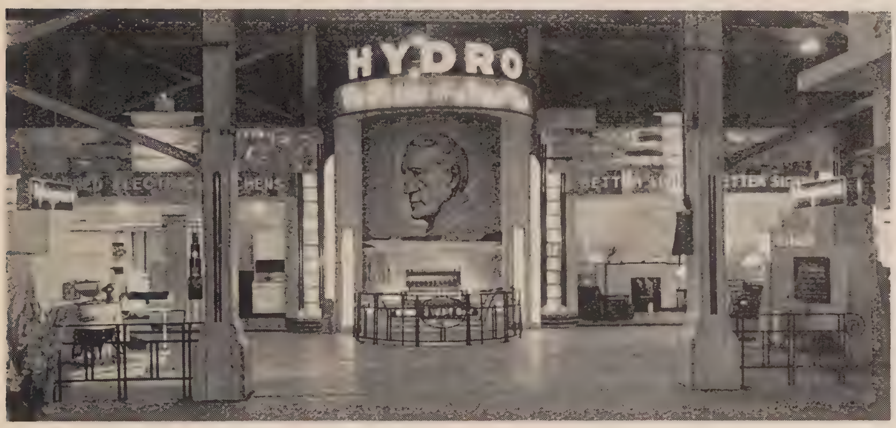
Year	Annual Revenue	Kilowatt-hours Consumed	Number of Consumers Billed *	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1928	$ 569,007.00	10,969,828	9,309	5.18¢	$4.97	96.1
1929	777,736.00	16,022,842	12,605	4.85	5.85	120.8
1930	863,805.00	20,507,063	16,011	4.21	5.03	119.4
1931	1,128,554.28	25,716,141	20,796	4.39	5.11	116.4
1932	1,255,482.13	28,675,400	22,432	4.38	4.84	110.5
1933	1,309,122.96	30,062,194	23,283	4.35	4.75	109.2
1934	1,319,922.69	33,312,314	23,882	3.96	4.66	117.7
1935	1,343,222.39	37,667,453	25,357	3.57	4.55	127.5
1936	1,385,784.39	45,447,669	28,198	3.05	4.31	141.4

*It may be observed that the number of consumers reported here do not agree with those shown in the Annual Report of the Commission. This is due to the fact that Class 2A consumers are considered as Hamlet consumers in this report and as Farm consumers in the Annual Report. Furthermore, the figures given here represent consumers actually billed, whereas the Annual Report shows the number of contracts executed to the end of each Fiscal year. In many cases service is not given until the following year.

The high average cost per kilowatt-hour for hamlet consumers is, of course, due to the additional service charge which has been part of rural rates for many years. It will be noted, however, that the average cost per kilowatt-hour is steadily reducing and with the reduction in service charge and rates this year there should be a marked reduction in the average cost for 1937 and 1938, with a corresponding increase in the average consumption.

Table No. X. shows the growth in revenue, consumption and the number of consumers among our farm customers for the past 9 years, as well as the average cost per kilowatt-hour, the average monthly bill and the average monthly consump-

tion, and a study of these figures shows that the annual revenue has almost trebled in the 9 year period; the kilowatt-hours are 4½ times what they were in 1928; the number of consumers has increased 3 fold. It is also interesting to note the gradual reduction in the average cost per kilowatt-hour and the average monthly bill, with a corresponding increase in the average monthly consumption, and with the reduction in service charges which goes into effect this year, the average cost to the consumer will be again reduced, and it is expected that the average consumption will be considerably enhanced.



General view of Hydro-Electric Power Commission Exhibit at the Canadian National Exhibition, 1937.

Farm machinery in Hydro Exhibit.

The Characteristics and Application of Modern Electrical Relaying

By E. M. Wood, Assistant Engineer, Electrical Engineering Department, H.E.P.C. of Ont.

A RELAY, in electrical practice, has been defined as "a device which is operative by the variations in one electric circuit to effect the operation of other devices in the same or another electric circuit." The owner of an early water-wheel driven generator for lighting his property who devised a push button arrangement so that he could shut down the water-wheel when he was ready to go to sleep, made use of a relay circuit to his great convenience. From such early beginnings, the application of relay devices to the control and protection of electrical and other systems has been extended until practically every branch of industry depends for control and safety on varied forms of these devices.

The peculiar susceptibility of electrical energy to control in this way has resulted in many relay and control devices being electrical in character even when not actually applied to electrical circuits. In a paper such as this it will not be possible to discuss all these applications. Attention will, therefore, be devoted chiefly to the field of protective relaying in power supply systems. A brief survey of some of the other fields is included as a matter of interest.

Relays of the control type find a widespread application in industry. More recently older types of relays are being supplemented by various classes of devices of the electron tube type. Equipment of these types in the proper combination can be used for the starting and stopping of motors and other devices, for automatic speed control, for control of sequences in various manufacturing processes and in numerous other ways to promote increased output of and accuracy in the product which cannot be obtained by other means. Examples are to be found in the modern paper and steel industries. In electric welding the rapid fabrication of structures is made possible by accurate control by means of relays and electronic devices; while applications of the photo-electric tube (the "electric eye") are becoming commonplace.

In the field of communication the setting-up of signalling and talking circuits is an important function of relay devices. Such relays are typically compact, reliable, inexpensive and of low energy requirement, so that they can be operated at distances of several miles over light

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Paper presented at the Semicentennial Meeting of The Engineering Institute of Canada, in Montreal, June, 1937, and printed in *The Engineering Journal*.

wire pairs in the ordinary telephone cable. Relays of a very similar type are used with such conductors for the remote control of apparatus in electrical supply stations, enabling several such stations to be controlled from a central point.

In cases where the stations are beyond the practical operating range of control over telephone wires, the functions may be performed by high frequency "carrier" currents transmitted over the power wires, so that the range of control is greatly extended. For example in the case of the transmission lines from the Boulder dam to the City of Los Angeles, an installation of control by "carrier" current applied to four conductors of the two main 287 kv. transmission circuits enables the operator at the generating station to control and obtain various indications from the receiving-end station some 270 miles distant, as well as from two intermediate line switching stations.

However, probably the most important form of relay application in the field of electric power generation and supply is that selected as the principal subject of this paper. "Protective relays", as they may be termed, perform the function of automatically ridding the system of any element which has developed an abnormal condition, usually an electrical fault or short circuit, as in the failure of insulation. The feature which characterizes modern practice in protective relaying is the development and growing adoption of methods for very rapid clearance of such faults. This has involved the development of high speed equipment in both relays and circuit breakers, because the total clearance time is the sum of the operating times of these two pieces of equipment.

It is of interest to note that use of most of the characteristic methods of high speed relaying is not new in this part of Canada. Such protective equipment has been advocated and quite extensively applied in Quebec province and to some extent in Ontario in the decade 1920 to 1930 though in conjunction with the standard oil circuit breakers of that period. A number of these installations have been described in papers presented to this Institute. Insofar as this author is aware, however, no other such installations were made up to about 1929.

The earlier standard types of relaying were based on the use of the induction disc relay similar in construction to the familiar watthour meter. The device is basically an inverse time or inverse definite time overcurrent relay, but with special adaptations may be made to function as a directional, current balance or differential relay and as a discriminating relay for voltage, power, frequency or other electrical quantity. It is rugged, accurate and reliable over long periods of hard usage and can be successfully applied in the following cases:—

Where the relay is required to carry a normal load current into the circuit protected not in excess of one-fourth the minimum sustained current that results from a fault in that section.

Where the relay is not normally

affected by load current, that is in differential or balanced connections, or when directionally controlled as at the receiver end of a line; also as a residual current relay for ground fault protection.

In the main high voltage network of most high capacity systems, or in any system where the capacity and loading of the circuits is high in comparison with the generating capacity connected, this type of relaying is clearly inadequate. It is too slow to hold stability between power sources or to prevent damage, and too dependent on connected generation for reliability. In such systems the increasing tendency at present is to adopt high speed methods of fault clearance.

Standard equipment now being offered in relays and oil circuit breakers for circuits of any voltage will clear faulty sections selectively in less than 0.2 sec. as compared to 0.5 to 5 sec. which may be required for selective clearance with the older type. In many cases, the older types of circuit breakers may be rebuilt to this standard at a moderate cost. Special oil circuit breakers are available at extra cost which with standard high speed relays will clear a circuit in less than 0.1 sec.

Characteristic Methods in High Speed Protective Relaying

The usual electrical supply system includes generators, transformer banks, busses, transmission circuits and feeders, each of which is referred or herein as an "element". A fault on any element of the system is detected by the protective relays which automatically open the switching devices to segregate the faulty element from the system. It is characteristic of modern relaying that the relays are arranged so that they are not affected by disturbances occurring anywhere in the system outside the element or elements which they protect.

Zone Differential Type of Protection

In a generating or distributing station, the busses, station circuits and equipment are usually grouped in a small area, the boundaries of each group being established by oil circuit breakers so that current differential protection can be applied to each group or zone. The essential features of such a protective scheme appear in Fig. 1. This shows *A*, a typical differential connection scheme; *B* and *C*, the principle of operation for sound and faulty zones respectively, and *D*, the wiring diagram of a station with complete zone protection.

While faults on busses are not frequent, they are usually accompanied by heavy fault currents which may cause serious damage and prolonged outage if not quickly cleared. If the failure is in an oil circuit breaker, delayed clearance may result in an oil fire.

Distance Type of Protection for Transmission Circuits

In the case of transmission circuits, the termini are usually too remote from each other to permit of the use of a simple current differential scheme. For protection of such circuits, stepped-range distance relaying of the impedance or reactance measuring type, with

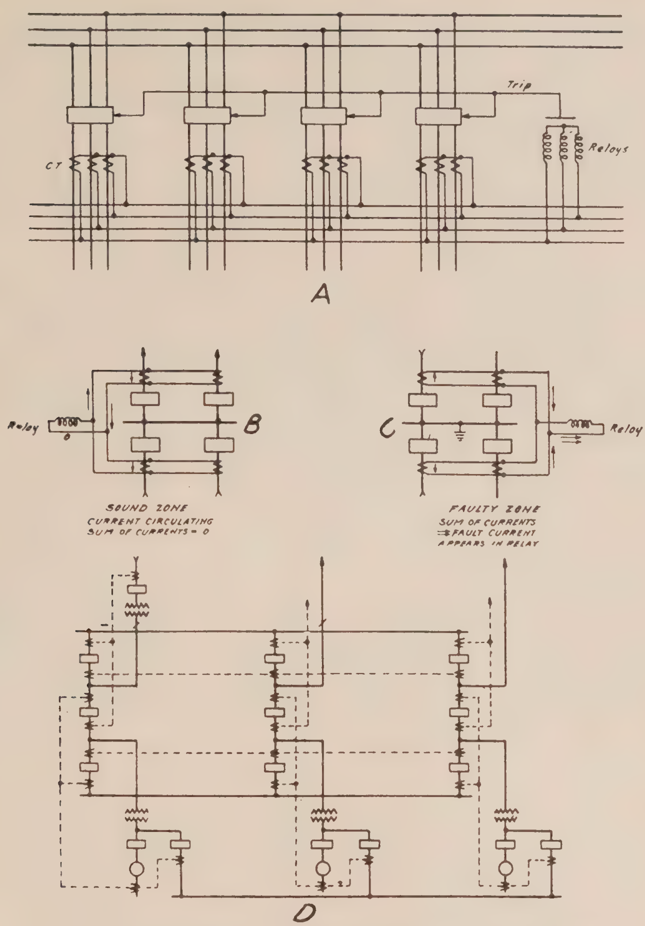


Fig. 1—Essentials of Zone Differential Protection.

directional characteristic where needed, is widely used. The principles on which this type of relaying is based and the manner in which it is applied are shown in Fig. 2. In this figure, *A* indicates the principles of impedance distance relaying; *B*, the connections of directional impedance relays for phase-to-phase faults; *C*, the application of the stepped ranges of distance relays to line sections of a system, and *D*, the time characteristic of a high-speed distance relay. An instantaneous impedance relay set for a balance point just short of the end of the section to be protected will not be affected by faults beyond its setting and will, therefore, be selective for external faults.

Due to limitations in the accuracy of the equipment, the highest speed of clearance is obtained for faults in about 80 to 90 per cent of the line adjacent to the relaying point. Beyond that point, protection is given by a

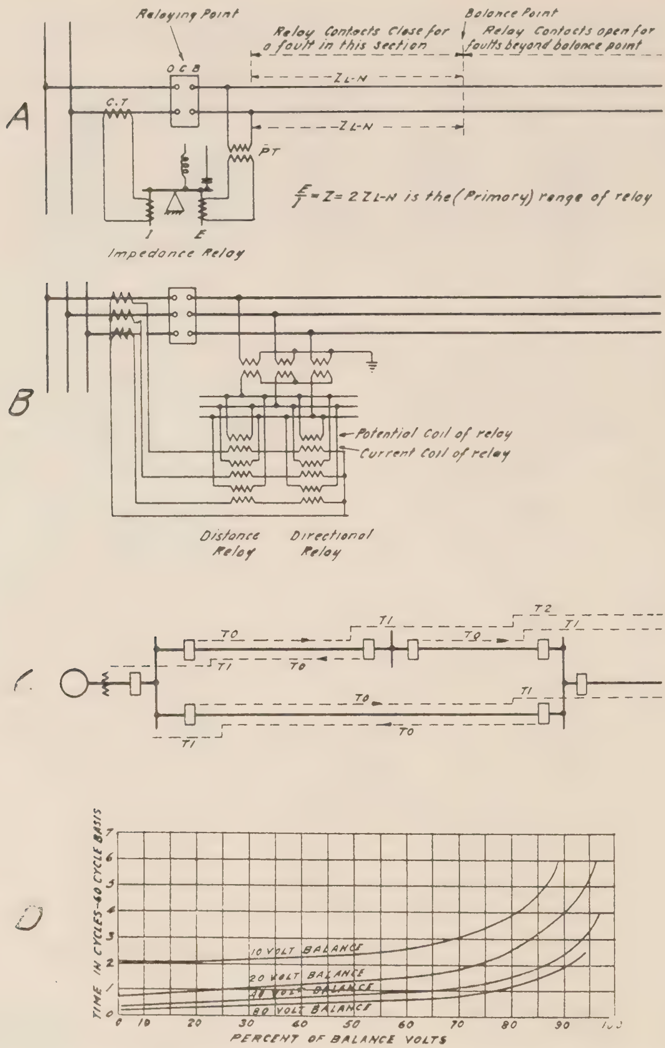


Fig. 2—Essentials of Distance Relaying for Transmission Circuits.

second relay of similar type which overlaps the other elements of the system but which is delayed in action so as to be time-selective with the instantaneous protections of those sections, providing a back-up effect for faults on a terminal bus or other elements. For more extended back-up effect, a third impedance element of still longer range and longer time delay may be provided.

The time characteristic of a typical high-speed element of an impedance relay is shown in Fig. 2D. These relays will operate accurately on values of fault current which, when flowing to a fault at the "remote end" of the line section will pro-

duce a voltage at the relaying point of 3 to 5 per cent of the normal value. The minimum effective value of fault current will depend on the impedance of the circuit, but in the case of overhead lines is usually well below normal load except in the case of very short sections. Because of this requirement, however, and because the impedance which may exist in an open arc will be added to the impedance of the line, creating an indeterminate factor for which allowance cannot be made in the relay setting, this type is not applicable to lines of very low impedance.

The impedance relay requires a continuous source of potential representing accurately the primary voltage at the relaying point. Safeguards must be provided against tripping in case of failure of this source.

Impedance relays are not suitable for "tapped" or "branched" lines where there is generation on the branches or where there are high capacity step-down stations; they will, however, function properly with small step-down stations tapped to the line section.

In the impedance form, they may fail to operate on high resistance faults such as those caused by trees over the line, until the resistance has been gradually reduced by charring. As ground relays, they are not very reliable on wood pole lines unless the hardware is grounded.

However, for flashovers, as from lightning or sleet, where the arc strikes cleanly, the impedance type relay is reliable and fast within its range.

They are subject to undesirable tripping when applied to sections of line interconnecting systems and power sources in cases of instability or of wide angular swings approaching instability. In such cases there will be a node of low voltage and high current in one of the tie sections, its location depending on the distribution of the impedance between the power sources. In such cases the impedance relays will operate as though there were a three-phase short circuit at the node and may open the interconnection at an undesirable location.

Pilot Type Protection for Transmission Circuits

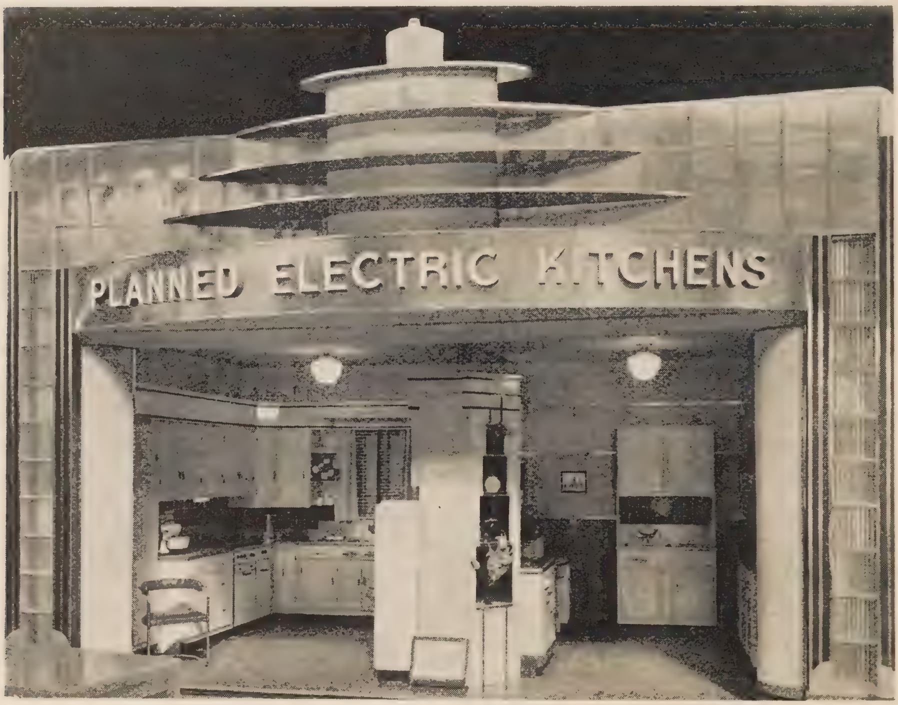
In this type of protection the relay installations at the terminal of the circuit are interconnected by a secondary or control circuit so as to give results similar to those obtainable on station zones—namely high speed clearance of any fault in the circuit without danger of tripping for any external condition. This type is theoretically the ideal.

Forms of it have been in use for many years, especially in England and to a much less extent in America. Its development has recently received much attention, so that equipment is now offered which will give very high speeds of complete fault clearance.

Pilot protective schemes differ greatly in details among various installations. For short feeders, the secondary current may be circulated over the pilot between the termini as in the zone differential in a station. In other cases the relays at

the termini may be interconnected by a control circuit by which the behaviours of direction elements are compared to determine whether the fault is internal so that tripping should be allowed, or external, in which case the circuit breakers are prevented from tripping. For circuits up to 10 to 12 miles in length this pilot circuit is often a pair of telephone wires, but where the line is much longer, it is usually more economical to utilize a high frequency carrier current system coupled to a conductor of the overhead transmission line. With the carrier system the length of the line protected may be of any length from one mile to 300 miles at about the same cost.

(To be continued)



Electric kitchen section of Hydro Exhibit.

Darkness Brings Death On Our Rural Highways

By Osborne S. Mitchell, Editorial Director, Electrical News and Engineering

DEATH is reaping a harvest on our highways every day in the year. Day after day he swings his scythe. Some days, one or two lives are snuffed out; other days, four or five are taken. More tragic still, for every one killed, twenty are injured. Last year in the province of Ontario alone over 10,000 people were injured in automobile accidents and 546 were killed.

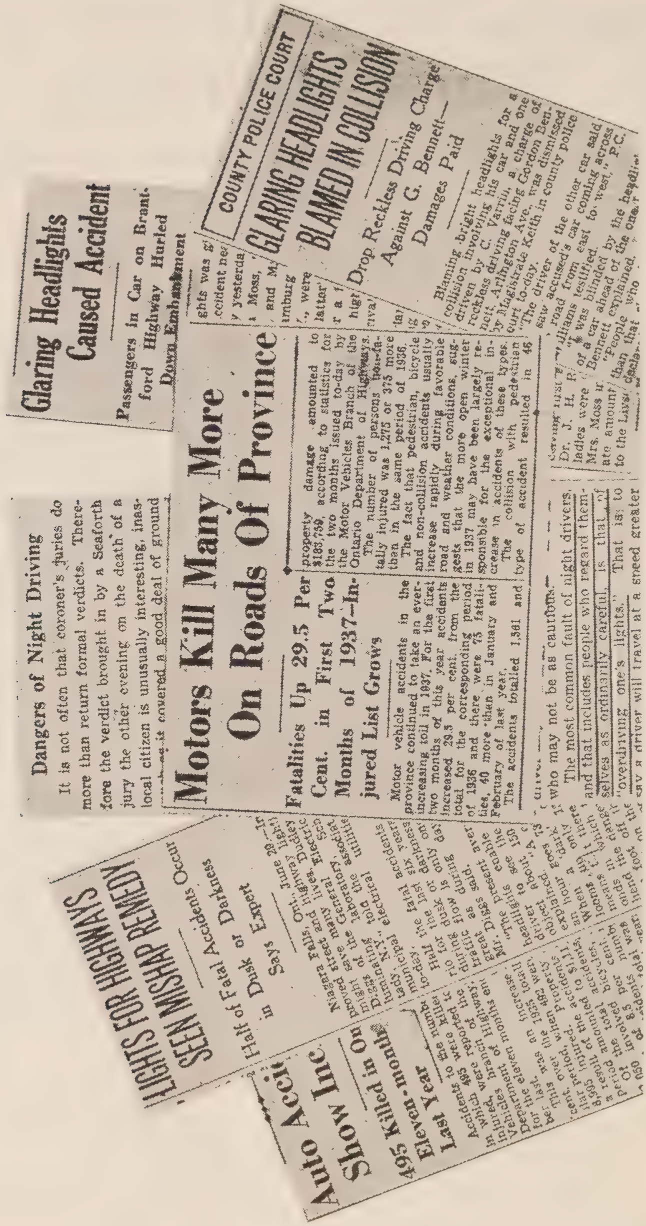
Fortunately the public is awakening to the seriousness of automobile accidents and many and sundry preventive measures are being suggested and used in an effort to stay death's hand. One school of thought believes that educational propaganda will result in safer highways by the voluntary co-operation of the driver; another school of thought believes that only by prohibitive measures can accidents be reduced. Both of these methods undoubtedly have their place and should have some effect in curbing accidents.

Nevertheless in our campaign of ways and means to lessen the daily toll of life we should try and determine the many factors responsible for automobile accidents and if possible pick out the more important for treatment. Some people claim, for instance, that alcohol is an important factor in causing accidents, whereas investigation shows that only about 1 per cent. of the drivers involved in an accident are intoxicated. Drinking, therefore, is only a minor factor, and while it should receive some consideration, our major efforts should be directed to more important channels.

Let us examine last year's accident record for Ontario and pick out what appear to be the important factors. This is comparatively easy to do because A. H. Rowan of the Accident Recording Division, keeps a very complete statistical record of all reported accidents.

Under "type of accident", we find out of a total of 11,388 accidents reported, 4,452 were "collision with other automobile"; 3,391 were "collision with pedestrian"; 1,127 were "collision with bicycle"; 673 were "non-collision accidents", and the remainder were "collision with other objects".

At first sight this looks as if "collision with other automobile" is the most important factor here. "Collision with pedestrian" ranks second; "collision with bicycle"—third; "non-collision accident"—fourth. This order of importance is also maintained in the record of persons injured. "Collision with other automobile" ranks first with 3,561 injured; "collision with pedestrian" comes a close second, with 3,307; "collision with bicycle" third, with 1,124; and "non-collision" with 687.



The Pedestrian Menace

When we examine the deaths caused by these accidents the order changes. Out of a total of 546 persons killed in these accidents, 235 deaths were caused directly by "collision with pedestrian"; 95 by "collision with other automobile"; 67 by "non-collision accident"; and 30 by "collision with bicycle".

From this analysis it is evident that *the most dangerous type of accident is "collision with pedestrian"*, for this type is responsible for nearly half of our automobile fatalities and a third of the injured.

Let us now examine the 16,070 drivers involved in these accidents, 15,037 of which were males. Nearly half, or 7,239, were between the ages of 25 to 40 years, and 12,099 had five years or more driving experience. This means that *most accidents are caused by responsible and experienced drivers.* Furthermore, we find that of the 16,070 drivers, 177 were intoxicated, 66 had some physical defect, 134 were suffering from extreme fatigue, but 15,693 were perfectly normal.

Our next inquiry should be: How do these accidents occur? According to the 3,698 reports, 1,184 drivers were driving too fast for road or traffic conditions, 1,011 were on the wrong side of the road, 564 did not have a right-of-way, and 572 drove off the roadway. Strange to say, only 116 were listed as cutting in and only 40 as passing on a curve or hill. Here the important factor apparently seems to be excessive speed and driving on the wrong side of the road. How important excessive speed is is something yet to be determined for it is based upon opinion. Undoubtedly it is an important factor for it is quite obvious that accidents would be greatly reduced if speeds never exceeded, say, 20 miles per hour. On the other hand, slow drivers on main highways are being pulled off the road by the police for endangering the lives of average-speed drivers. The other important factor, "driver being on the wrong side of the road", is not very helpful to us unless we know whether they turned out to avoid an obstruction, were driving on the wrong side without any reason, or were driving just over the centre. Perhaps we can justifiably sum up by saying that the majority of accidents are caused by recklessness, although perhaps ignorant recklessness.

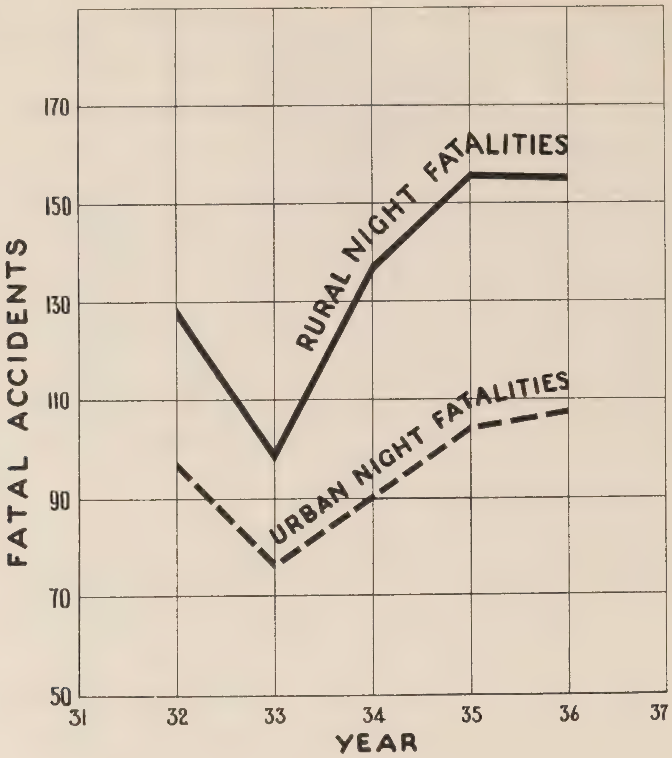
Straight Roads Dangerous

Our next investigation, into "direction of travel", however, leaves no doubt in our mind. Out of 16,750 drivers involved in accidents, *12,772 were going straight*, 1,376 were turning left, and the remaining doing other things.

Now let us examine the type of vehicle. Out of 16,750 accidents, 15,124 had 4-wheel brakes, 13,419 were passenger cars, 2,672 commercial vehicles, 258 motor-cycles, 193 taxicabs, 85 busses, and the remainder other vehicles. It is evident, therefore, that *the greatest responsibility rests with the modern private passenger car.* This is also borne out by the report that the brakes of 15,911 were reported in apparent good condition, and that 15,124 had semi-balloon tires.

Most Accidents in Good Weather

Next we must know the weather and road conditions. Of the 11,388 accidents, 7,870 occurred in clear weather and were responsible for 363 of the 501 fatal accidents. However, *7,242 accidents and 361 fatal accidents occurred on dry surfaced roads.* This means that in bad weather drivers must be more cautious for only 55 fatal accidents occurred on snowy or icy surfaced roads, 83 on wet surfaced roads, and 16 on muddy surfaced roads.



Five years' record of night fatalities in Ontario. The drop in 1933 is due to the depression, less gasoline being sold.

MOST RURAL NIGHT ACCIDENTS

Finally, where and when did these fatal accidents happen? Last year we *discover that 308 out of 501 fatal accidents occurred on rural highways and of the 308, 153 happened at night.* What does this mean? We know that the traffic is far denser in cities, towns and villages than it is in the country, and yet three-fifths of all fatal accidents happen on rural roads. We also know that only one-fifth of the traffic flows at night, yet rural night fatalities are equal to rural day fatalities. It surely means that *the most dangerous of our roads are our rural highways at night.*

Let us now summarize our findings:

1. The most dangerous type of accident is "collision with pedestrian".
2. Most accidents are caused by responsible and experienced drivers who are normal at the time of accident.
3. "Excessive speed" and "wrong side of road" are main factors causing accidents.
4. Vast majority of accidents caused by modern private automobiles in good condition.
5. 70 per cent. of fatal accidents occur on dry roads—and the majority in clear weather.
6. The most dangerous roads are rural roads at night.

These findings surely indicate that *we should concentrate our greatest efforts on trying to reduce night-time rural accidents.*

Important factors involved in night-time rural accidents we know are: The pedestrian, the driver, speed, visibility, and traffic density.

Educational propaganda can be used to good advantage in trying to get both pedestrians and drivers to avoid hazards, but how successful this method will be is problematical. Next we could prohibit high speeds and also prohibit pedestrians from using the highways at night. Again, the success of this method is problematical. The traffic density factor will certainly become steadily worse, unless we prohibit the use of highways after dark. The only remaining factor then, is visibility.

Importance of Visibility

How important is this visibility factor? All the night rural accidents recorded in Ontario happen on unlighted roads, or rather on roads lighted only with the driver's headlamps. Furthermore, the vast majority of these night accidents occur in clear weather on paved roads—when the visibility is at its best.

Seeing along highways at night is influenced by a number of factors, such as colour of the road, its specularity, and the contrast between the pavement and the road shoulder; but the most important factor is the lighting. With proper and adequate illumination, seeing is quick and certain. With poor lighting it is not. Therefore, the problem of traffic safety on highways at night is largely a matter of proper illumination by automobile headlamps or by fixed highway lighting equipment, or by both.

Investigation has shown that a dark object on a new concrete pavement becomes visible at 105 ft. to a motorist travelling at 40 m.p.h., when using good headlamps giving 6,000 beam candlepower. Tests show, however, that from the time the motorist sees the object to the time he can stop will amount to at least 120 ft. This means he will either hit the object or swerve to one side, probably causing an accident. Remember, these are ideal conditions. Few pavements have a light reflection factor as high as clean concrete. Asphalt or bituminous macadam have low reflection factors, which means that *motorists travelling at average speeds have little or no chance of stopping in time to avoid accidents when driving on dark highways.*

The use of automobile headlamps is not only ineffective in practice, but it is scientifically wrong. It is well known that the ability to see and recognize obstructions on the highway depends not upon intensity of light but upon contrast. Besides, for headlamps to be effective they should be much more powerful than is legal, in which case they would increase the hazard for oncoming traffic. Whereas, with properly designed highway lighting, even of a comparatively low intensity, it is quite possible to see a pedestrian silhouetted against the lighted background of the road at a distance several times greater than could be seen with even the most powerful headlights.

Surely the time has come for us to

Adequate lighting saves many lives.

do something about decreasing night accidents—particularly on highways. Highway lighting installations in several parts of the United States have already decreased night accidents approximately 40 per cent. Similar installations in Europe are doing likewise.

QUESTION OF COST

The question of cost is not as important as many think. The motorist is already paying for highway lighting without getting it. In fact if all the money collected in gasoline taxes and license fees was spent only on highways, there would be enough left over to light all the more heavily-travelled main highways. Furthermore, the amount saved in the reduction of accidents would be considerable. Last year in Ontario the property damage caused by motorists amounted to over 1¼ millions of dollars, but the resultant economic loss to the country caused by the 11,388 accidents was around $25,000,000.

Surely adequate highway lighting is an economic necessity!

Lost,—A Planet

THERE is good evidence that a planet has been lost somewhere between the orbits of Mars and Jupiter. It seems to have been small, only one-tenth of the diameter of the earth, and to have had a period of about 3.3 years, but it either was spoiled in the making or else it exploded after it was formed.

That something is missing here is apparent when the planets are numbered consecutively, commencing with Mercury, and their distances plotted according to their numbers. Two graphs, "a" and "b", Fig. 1, are then obtained and there is definitely a break between these curves. However, when the planets beyond Mars are each given the next higher number—as though there were a planet between Mars and Jupiter—and their graph replotted, being curve "c", the consistency of curves "a" and "c" is then quite evident. It would seem that they are intended to form the one continuous curve, which suggests a certain order in the spacing of the planets but requires the lost one to complete the chain. As the missing planet cannot be found, perhaps some other accounting for it may be given.

Kepler, the Danish astronomer, noticed this wide gap between Mars and Jupiter and could not explain it. Later, when Uranus was discovered, and found to be in accordance with

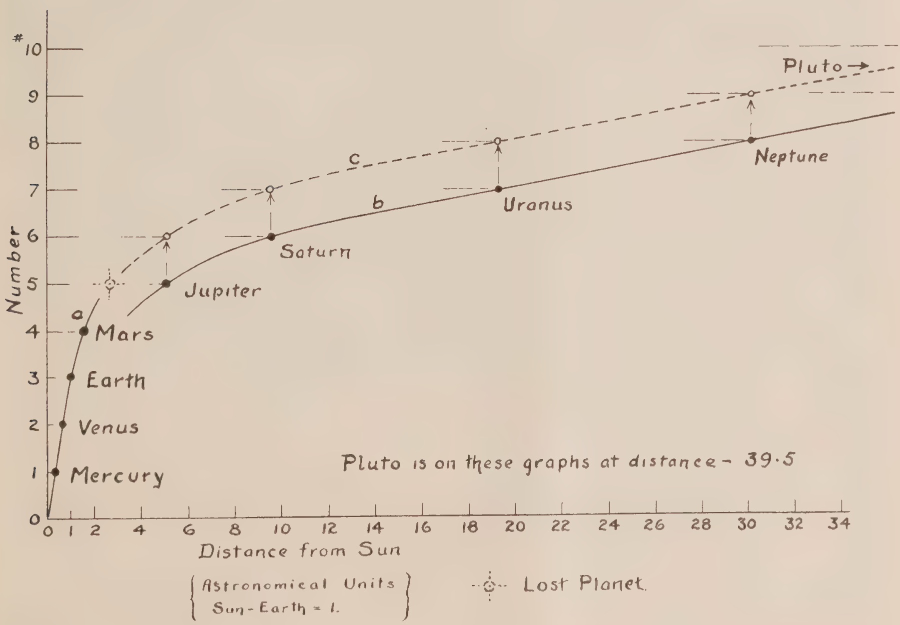


Fig. 1—The planets numbered, and their distances from the sun plotted, indicates that there should be a planet between Mars and Jupiter.

the spacing of the other planets, the possibility that one planet had been lost became fairly conclusive.

Found—Asteroids, by the Hundreds

On January 1, 1801, the first night of the nineteenth century, Piazzi, an astronomer in Sicily, discovered a small star. It had not been there before and it moved from night to night. He named it Ceres, and it turned out to be a very small planet, about 480 miles in diameter. In 1802, another one was discovered, by Olbers, and named, Pallas; it has a diameter of about 304 miles. In 1804, a third one was found, by Harding; it was about 120 miles in diameter, and he gave it the name, Juno. Then Olbers, in 1807, discovered still another, Vesta, about 240 miles in diameter—the only one ever visible to the unaided eye.

Thus four small planets had been found and for these Sir William Herschel suggested the name "asteroid," meaning starlike.

The hunt for asteroids was kept up for several years but no more were found—chiefly because the searchers did not look for very small objects. In 1845, however, after fifteen years of unsuccessful work, Hencke discovered the fifth asteroid, Astraea. In 1847, three more were seen, and each year thereafter any number from 1 to 100 new asteroids were located. For a time, hunting for asteroids was quite a popular pastime. In 1924, the total reached 1,000, for all of which the orbits were known, and there were 500 or more others which had been found but lost again because their orbits had not been determined. There probably are over 2,000 of these small bodies, moving in various orbits, and being the remaining evidence of a planet that once existed.

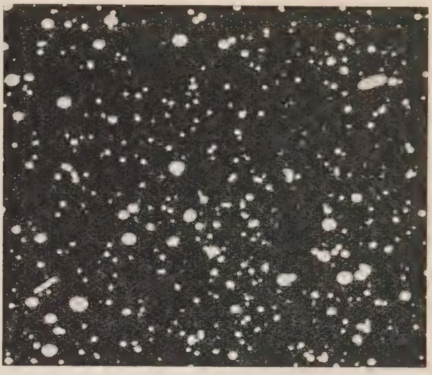


Fig. 2—Asteroids are discovered by their trails when the camera is following the stars. Two trails are shown here.—Yerkes Observatory.

Hunting Asteroids

The early hunter made specially accurate star charts and then searched for new stars, and watched for motion on successive nights. The camera was introduced by Max Wolf in 1891; he mounted the instrument and drove it by clockwork, so that it would follow the stars. On long exposures, then, the asteroids would show trails while the stars would only be points, Fig. 2. An improvement in this method consisted in following the asteroid; if this can be done, the stars show trails and the faint asteroid then appears as a more intense point. There is difficulty here, of course, in estimating the rate of motion of the unseen body.

The Orbits of Asteroids

The nearest asteroid is Eros; it comes closer to the earth than Mars or Venus but its orbit is very eccen-

tric (0.223) so that when at greatest distance it is well outside Mars' orbit. This little planet is about 15 miles in diameter; its period is 643 days.

The farthest asteroid is Hidalgo with its orbit inclined 43° to the plane of the earth's orbit. Its period is 13.7 years—two years longer than that of Jupiter.

The Trojan group, named after heroes in the Trojan War, are of particular interest. They are together on an orbit which is about the same as Jupiter's orbit, and are at one corner of an equilateral triangle—this planet and the sun being at the other corners.

About ninety per cent. of the asteroids, however, have orbits nearer to Mars than to Jupiter, and have periods ranging from 3½ to 6 years.

The orbits of some asteroids are very eccentric, which means that they are elongated ellipses with the sun far from the centre. There then will be very great differences between the perihelion and aphelion distances,—i.e., respectively, their nearest approach to and greatest distance from the sun. The most eccentric orbits are those of Hidalgo, (0.65) Albert, (0.54) and Alinda, (0.53).

Some of the asteroids have been observed to rotate on their axes. On none, however, have surface details been seen.—*F.K.D.*

Better Lighting section of Hydro Exhibit.

Water Power Resources of Canada

THE Dominion Water and Power Bureau of the Department of Mines and Resources, Ottawa, presents a summarization of data and a brief discussion of the progress in the development and utilization of the developed and undeveloped water power resources of Canada.

Total Available and Developed Water Power

All existing stream flow and power data available from federal, provincial and private sources have been systematically collated, analyzed and coordinated with a view to presenting a dependable estimate of available power based upon uniform methods of computation and arrangement. The results of these studies indicate available water power totalling 20,347,400 h.p. under conditions of ordinary minimum flow and 33,617,000 h.p. ordinarily available for six months of the year. The total turbine installation is 7,945,590 h.p.

The total turbine installation of 7,945,590 h.p. represents the sum of the manufacturers' ratings of the different units under the heads at which they are installed. It is not correct to subtract this figure from the totals of available power to determine what power remains undeveloped because it has proven sound practice to allow a turbine installation averaging 30 per cent in excess of the ordinary six month flow power. The present turbine installation, therefore, indicates the development of only a little more than 18 per cent of the present recorded water power resources of Canada.

The water powers of the Maritime Provinces while small in comparison with the sites in the other provinces constitute a valuable economic resource, the development of which is supplemented by power from abundant indigenous coal supplies. Quebec with large resources of water power has achieved a remarkable development during the past ten years, her installation considerably more than doubling in that period. Almost eighty-five per cent of her total installation is operated by nine large central station organizations. Ontario, like Quebec, without local coal supplies, also has abundant water power resources. The Hydro-Electric Power Commission of Ontario, a co-operative, municipally-owned enterprise, province-wide in its field, operates plants aggregating almost sixty-three per cent of the total hydraulic installation of the province and serving 766 municipalities. Of the Prairie Provinces, Manitoba has the greatest power resources and the greatest development, seventy-eight per cent of the total hydraulic development of the three provinces being installed on the Winnipeg river to serve the city of Winnipeg and adjacent municipalities and over the transmission network of the Manitoba Power Commission some sixty municipalities in South-

ern Manitoba. In the districts containing least water power, the southern portions of Alberta and Saskatchewan, there are large fuel resources. British Columbia, traversed by three distinct mountain ranges, ranks fourth in available power resources and her hydraulic development is exceeded in only Quebec and Ontario. The water powers of the Yukon and Northwest Territories, while considerable, are so remote from markets as to limit their present commercial development to local mining uses.

The significance of the distribution of Canadian water power resources is apparent when it is stated that approximately 60 per cent of the total available water resources and more than 81 per cent of the developed water power are located in the highly industrialized provinces of Ontario and Quebec in which there are no natural coal deposits.

Current Progress

As a result of reduced power demand no large hydraulic plants were placed under construction subsequent to 1931. The installation of units in plants not completely installed was, however, proceeded with following the revival in power demand which became evident early in 1933. This movement apparently culminated in 1935 with a net gain for that year of more than 360,000 h.p. followed by an installation of only 36,475 h.p. during 1936, the lowest increase of any year since 1903.

Utilization of Developed Water Power

The analysis of the utilization of developed water power shows the total installation of 7,945,590 h.p. being divided as between central electric stations, pulp and paper mills, and other industries.

Central electric stations, i.e., organizations distributing electricity for sale to the public, maintain a hydraulic installation in their generating stations of 6,982,541 h.p. or 87.9 per cent of Canada's total hydraulic development. The central electric stations operated by this hydraulic equipment produce more than 98 per cent of all electricity generated in Canada for sale.

The installation in pulp and paper mills totals 605,346 h.p. or 7.6 per cent of the total. This installation, considerable as it is, does not present a true picture of the power demand of this important industry but must be considered in conjunction with the large electric motor installation maintained in the mills for operation by power purchased from the central electric stations.

The installation for other than central electric station and pulp and paper use, is 357,703 h.p. or 4.5 per cent of the total. This includes the hydraulic power installation of saw, grist and grinding mills; municipal water supply systems; mining, metallurgical and electro-chemical works; electric railway systems, and other miscellaneous industries.

The average installation per 1,000 of population is shown to be 720, a total which places Canada well to the front amongst the water power using countries of the world.

Water Power in the Central Electric Station Industry

Practically all new hydraulic construction of recent years has been

carried on by central station organizations. In the ten year period between the end of 1926 and the end of 1936 the central station hydraulic installation increased by 3,274,259 h.p. as compared with an increase of 105,958 h.p. for all other purposes, i.e., only 3 per cent of the total hydraulic installation of the past ten years has been installed by other than central station organizations.

With an average revenue per kw-hr. for all hydro-electricity produced of only .51 cents and of only 1.95 cents per kw-hr. for all hydro-electricity sold for domestic and farm use Canadian central stations provide a service countrywide in its scope and within reach of practically all classes of the population and applicable to all forms of industry. This has resulted in a remarkable record of demand even during the years of unfavourable commercial and industrial conditions. Successive annual increases in the output of hydro-electricity were recorded in each of the years 1922 to 1930. A decline in output which commenced in July, 1930, resulted in a decrease in the 1931 output of less than 10 per cent followed by a further decline of less than 2 per cent of the 1931 output in 1932. The downward movement terminated in April, 1933, with the output for May exceeding that for May, 1932, and each successive month from May, 1933, to December, 1936, — the latest for which figures of output are available—has shown increased output over the corresponding month of the preceding year. According to the latest figures released by the Dominion Bureau of Statistics the total output of central electric stations during 1936 was 25,493,474,000 kw-hr. a gain of more than 60 per cent over the low of 1932. Slightly more than six per cent, 1,578,107,000 kw-hr. was exported to the United States and the remainder, plus a small import from the United States was consumed in Canada, the amount so consumed being 23,911,306,000 kw-hr.

Water Power in the Pulp and Paper Industry

Canada's pulp and paper industry ranks first amongst her manufacturing industries leading all others in gross and net value of product, total number of persons employed, and in salaries and wages paid. Its development has been extremely rapid, the output of its chief product, newsprint, which totalled 350,000 tons in 1913, the first year for which complete figures are available, increasing to 3,190,000 tons, an all time record, in 1936 or more than 9 times the 1913 output. It is estimated that the 1936 output represents 40 per cent of the world production for that year.

The hydraulic turbine installation in the mills totals 605,346 h.p. of which 463,040 h.p. or 76½ per cent is installed in Ontario and Quebec, while 87 per cent of the electricity purchased for power purposes and 99 per cent of the electricity purchased for steam raising is also utilized in these two provinces.

Water Power in the Mineral Industries

The value of Canadian mineral production established a new high

record in 1936 amounting to approximately $350,000,000 as compared with $312,000,000 in 1935 and $310,000,000 in 1929. Both gold and base metal production attained new high levels. A considerable number of mines in new areas came into production and activity in the established areas increased.

The rocks of the great Laurentian plateau or Pre-Cambrian Shield which occupies 60 per cent or more of Canada's mainland are remarkable for the variety and extent of their mineral deposits. This area contains more than 57 per cent of Canada's available water power while a further 17 per cent occurs in British Columbia and the Yukon and Northwest Territories in both of which mining is most active.

Although the power requirements of the mineral industries in Canada are in excess of one million horsepower well over eighty per cent of which is derived from water power.

Water Power in Other Industries

In addition to maintaining the hydraulic installation of 357,528 h.p. these diversified industries provide a broad market for hydro-electricity generated by the central electric stations by purchasing power to operate an electric motor installation of some one and one-half million horse-power.

Capital Invested in Water Power

The present hydraulic installation of 7,945,590 h.p. represents a total investment conservatively estimated at $1,590,000,000.

Coal Equivalent of Developed Water Power

The extensive utilization of water power, without doubt, has had a pronounced effect upon the consumption of coal and other fuels in Canada.

Comparing the water power development in the Dominion with a corresponding development of fuel power indicates that each installed hydraulic horse-power if operated continuously throughout the year would effect a saving of about 4¾ tons of coal or that the present installation of 7,945,590 h.p. is capable of effecting a saving of thirty-seven and two-thirds million tons of coal.

During 1936, Canadian consumption of electricity produced in central electric stations was 23,911,306,000 kw-hr., about 98 per cent. of which was hydro-electricity including 6,922,840,000 kw.h. sold for electric boiler use. Adding to these figures a conservative estimate of the power output of non-central station hydro plants indicates that the water power used for general power purposes effected a saving of more than 14,475,000 tons of coal while in electric boilers the saving amounted to 1,150,000 tons. That is, during 1936, water power effected an actual saving of more than 15,625,000 tons of coal.

G. G. Green, Bradford

George Gibson Green

George Gibson Green, Clerk of the village of Bradford and Secretary of the Bradford Public Utilities Commission died unexpectedly at the Private Patients Pavilion, Toronto General Hospital on Friday, July 16, 1937. While feeling and appearing to be in excellent condition physically, he had observed some rather alarming symptons, which caused him to come to Toronto about three weeks prior for a thorough medical examination. A condition was disclosed for which a major operation was necessary to remedy it. A few days later, the operation was performed successfully and he and his friends had high hopes that a cure was effected. On the ninth day following the operation a condition developed from which he passed away on the following morning.

Mr. Green was born sixty-three years ago in Bradford, where he spent his whole life. After leaving school he worked for a number of years in his father's store, after which he went into the insurance business. For many years he was prominent in business, municipal and other activities in the village. He had been secretary-treasurer of the Bradford and West Gwillimbury Agricultural Society for 29 years and was manager of the local Bell Telephone and Express offices. For the past 24 years he was clerk and treasurer of the village of Bradford, and secretary-treasurer of the Bradford Hydro Commission since its organization in 1918. The loss of his experience in these and other activities will be felt keenly.

Mr. Green is survived by his widow and two daughters to whom we extend our sympathy in their loss.

THE BULLETIN

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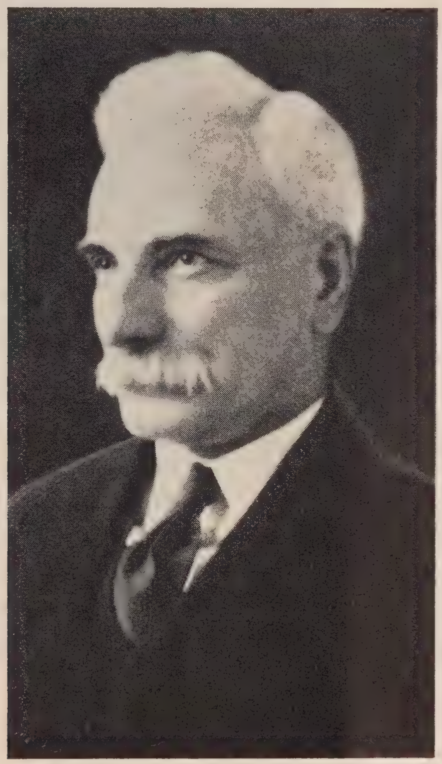

T. Stewart Lyon.

ANNOUNCEMENT has been made of the appointment of new personnel on the Board of the Hydro-Electric Power Commission of Ontario, to whom reference is made elsewhere in this issue. By the change the Chairmanship of T. Stewart Lyon has ended, his resignation having been accepted by the Prime Minister of the Province of Ontario.

By Mr. Lyon's retirement there has

withdrawn from public life one who during the early days of Hydro was a strong supporter of the scheme and leant his efforts towards advancing the work.

We take this opportunity to extend to Mr. Lyon our good wishes on his retirement, and hope that he may be long spared to enjoy the best things of this life.

The New Hydro Commissioners

THE BULLETIN wishes to extend to the three new Commissioners of the Hydro-Electric Power Commission of Ontario, as a group, its hearty good wishes as to the future of each member. The appointment of Dr. Thomas H. Hogg, as Chairman, the Honourable William L. Houck as Vice-Chairman, and J. Albert Smith as third member gives us this opportunity of extending to each our heartiest congratulations.

* * * *

Thomas H. Hogg, B.A. Sc., C.E., D. Eng., Chairman

Dr. Thomas H. Hogg.

Thomas Henry Hogg was born at Chippawa, Ontario, in 1884 and educated at Niagara Falls Collegiate Institute and the University of Toronto, receiving the degree of Bachelor of Applied Science in 1907. In 1912 he received the degree of Civil Engineer from the University of Toronto and during the University's centennial celebration in 1927, was given the honorary degree of Doctor of Engineering. From 1909 to 1911 Dr. Hogg was with the Ontario Power Company at Niagara Falls, after which he served as editor of *The Canadian Engineer*. In 1913 he came to the staff of the Hydro-Electric Power Commission of Ontario as Assistant Hydraulic Engineer and in 1925 was appointed Chief Hydraulic Engineer. He now holds the position of Chief Engineer of the Commission.

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The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

Dr. Hogg has a wide experience in engineering work, having served as Consultant on many projects outside of the Commission, some of the more important of which were—

To the Federal Government of Canada on the Ghost Development of the Calgary Power Company in Alberta.

To the Consolidated Smelters in British Columbia on the application to the International Joint Commission for storage of water on the West Kootenay River in the United States.

To the Manitoba Government in connection with the power policy of the Province.

To the Ontario Department of Lands and Forests.

On the development of the Mersey River in Nova Scotia as well as various other power projects throughout the Dominion of Canada.

He is a member of the Lake of the Woods Control Board and acted for the Province of Ontario in conjunction with the Canadian Section of the Joint Board of Engineers on the St. Lawrence Waterways project. He has also collaborated on reports on various projects in the United States.

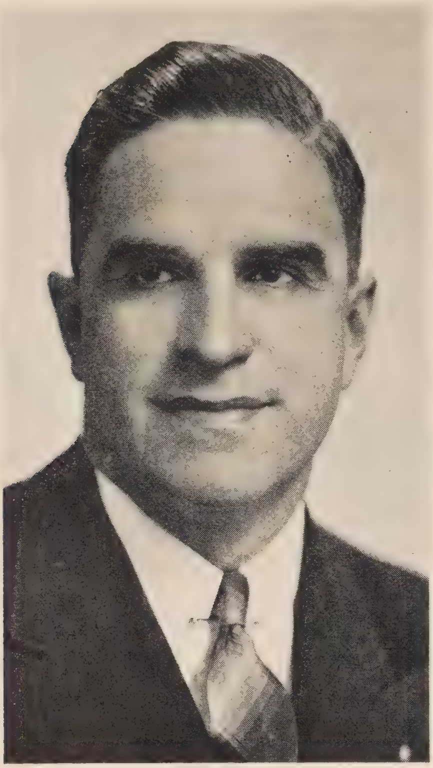
Dr. Hogg is a member of many institutions and professional societies in both Canada and the United States.

* * * *

Honourable William L. Houck, B.Sc., M.L.A., Vice-Chairman

William Limburg Houck was born in Buffalo, N.Y., in 1893, and received his education at Lafayette High School, Buffalo, and Cornell University, graduating with the degree of Bachelor of Science (in Agriculture). On graduation he came to Canada to operate a 1,000 acre farm near Niagara Falls, purchased in 1911. In 1926 he was naturalized a Canadian citizen.

Mr. Houck entered public life when he was elected member of the Legislature of the Province of Ontario in 1934. Since his election he has served as a member of the Queen Victoria Niagara Falls Park Commission. After his re-election on October 6th he was made Minister Without Portfolio and Vice-Chairman of the Hydro Commission.



Hon. William L. Houck.

J. Albert Smith.

J. Albert Smith, M.L.A., Commissioner

Justus Albert Smith, the third member of the Hydro Commission was born at New Hamburg, Ontario. While he was quite young his parents moved to Berlin (now Kitchener) where he still makes his home. He received his education at Kitchener Public Schools and Kitchener and Waterloo High Schools. On leaving High School he entered the employ of The Mutual Life of Canada and later the sales organization of the Canada Cement Company, Limited, with which company he is still associated.

In 1926, Mr. Smith was elected to the Kitchener City Council where he served for eight years. In 1935 he was elected Mayor of Kitchener and in 1936 and 1937 returned to that office by acclamation, being one of the youngest mayors in Ontario and the first to be elected mayor by acclamation in the history of that municipality. For the last year and a half he has been President of the Ontario Mayors' Association, of which organization he had been Secretary previously. He is also an officer of the Dominion Mayors' Association and a Vice-President of the Ontario Municipal Electric Association. Mr. Smith

takes a great interest in horticulture, having served as President of the Ontario Horticultural Association during 1931. At the recent provincial election Mr. Smith was elected member of the Ontario Legislature for North Waterloo and later was appointed Hydro Commissioner.

View along one street of the concession area.

Hydro Demonstration at the International Plowing Match

THE International Plowing Match and Farm Machinery Demonstration of the Ontario Plowmen's Association was held this year on October 12th to 15th at Fergus, in Wellington County.

In spite of the weather, which was unusually cold with frequent snow flurries, the match was the most successful ever held by the Association. The attendance was estimated at 110,000 people, and no doubt, would have exceeded this had the weather been more favorable.

There were 590 entries in the various plowing contests, which considerably exceeded those previously experienced. The 66 exhibits, exclusive of caterers, in number and size exceeded those of previous years, and necessitated extending the concession area to provide an additional 600 feet of frontage. The concession area completely occupied a 10-acre "L"-shaped field immediately adjacent to Beatty Brothers factory. All lots faced on two 50-foot streets radiating from headquarters, the total frontage of concession lots being 3,000 feet.

The Commission's electric system required 600 feet of 2,300-volt line, and 1,800 feet of 110-220-volt line, the erection of two 15-kv-a. transformers and eight street lights.

View along the other street of the concession area.

Thirty-five services were connected with a load of 27 kilowatts.

The Commission's demonstration was housed in a tent 38 feet by 70 ft., divided into sections by a partition part way across the tent. One side was devoted to household equipment and appliances, a complete line of electric ranges, washing machines, ironers, refrigerators, radios and small appliances being on display, which attracted a greal deal of attention. The other half of the tent was devoted to grain grinders, milk coolers, milking machines, cream separators and a full line of deep and shallow-well automatic water pumping systems to meet practically all requirements. An interesting exhibit of motors and motor parts was also displayed. The equipment display was loaned by manufacturers who had representatives present to give complete information, and also members of the Commission's staff were in attendance to give informa-

Some of the visitors to the Hydro exhibit.

Household appliance exhibit.

Small motors, grain grinders and dairy equipment.

Pumping equipment displayed.

General view of one plowing area.

tion on rural electric service. Throughout the match, the Commission's tent was well filled with interested visitors, the small grain grinders, water systems and household equipment attracting the greatest attention.

The Commission's prize consisting of a half-horsepower motor as first prize in class 6 tractor plowing, was won by Mr. Clifford Yule of Hagersville, a rural consumer, who expressed himself as particularly pleased with the prize as he had an immediate application for it in pumping water.

The match was concluded by a banquet provided by the County of Wellington, at which approximately 1,000 attended.

The Plowmen's Association and local committees are to be congratulated on the intense interest and remarkable growth that have developed in this annual affair.

Getting Results in Rural Electrification

By H. D. Rothwell, B.A.Sc., Assistant Engineer, Municipal Engineering Dept., Hydro-Electric Power Commission of Ontario

THE creation of the Hydro system in the province of Ontario had as its primary purpose serving the large urban centres with electrical power. At its inception, power was purchased from a private company in Niagara Falls, at which point existed the only major source of electrical energy generated from water power in the province of Ontario.

In order to make this cheap source of energy available to the various urban centres, who to that time were dependent largely on local plants, a partnership was created between a number of the larger urban communities for the purpose of obtaining united action, which resulted in pooling their financial resources in order that an undertaking of this magnitude might be successful. With a partnership established, it was necessary to delegate to some central authority the power to carry out the undertaking and to administer it on behalf of the partner municipalities. The authority so created is known as the Hydro-Electric Power Commission of Ontario, which was formed in 1906. Distribution of electricity to fourteen municipalities was commenced in October, 1910, and has expanded steadily in the past 27 years, until today practically all the electrical energy used for municipal purposes is supplied through the medium of the Commission.

Provision was made in the original partnership scheme whereby other municipalities might be admitted and receive the benefits of cheap electrical power in a similar manner to that of the pioneers, the only condition imposed being that each would assume its share of the financial obligations and undertake to pay for power received at cost, a basis which has been conducted impartially since its inception. The result of this may be followed from year to year in the Annual Reports of the Commission.

Soon after the urban municipalities' needs were being satisfied, the more far-sighted statesmen could see that the new standard of living set up in those municipalities would create a desire for a similar standard in the rural sections, and it was believed that plans would eventually be necessary to supply this demand. About 1912 or 1913, trial line extensions were constructed, radiating from some of the larger centres then receiving Hydro service. These were followed by larger systems constructed in certain townships adjacent to a city or town, from which electric service was made available to the rural communities, in a more-or-less experimental way, and from which nuclei the present rural systems throughout the province of Ontario have grown.

The entrance of Canada into the Great War necessitated discontinuance of any further projects on a large

scale until its close. In 1919, however, the demand for electric service was more insistent than ever, primarily due to a change from the economic conditions existing previous to the war, which necessitated intensive studies being made of the rural problem for the purpose of extending service to agriculture on a large and comprehensive plan, that would ultimately embrace the entire province. These studies were for the purpose of determining the capital cost, with its attending annual charges, of serving the average rural consumer in the way of lines, transformers and equipment to provide the necessary service, the density that might be expected, and also the more likely areas in which service would in the near future be demanded. These investigations enabled the Commission to determine a policy which would fit into the scheme that might be decided upon.

In serving rural communities, the primarily important information is an intensive study of farm economics in order that an evaluation may be made as to the ability of the agriculturist to pay for the electric service rendered, which must include a determination of his requirements, keeping in mind, as far as possible, the economical replacement of any existing source of power now in use. To have a comprehensive idea of this problem, it is necessary first to have an intimate knowledge of the type of agriculture; that is to say, whether the area is general, dairying, market gardening, fruit growing, etc.

In a broad sense, the province of Ontario is divided into three general sections. That part of the province which is bounded by Georgian Bay, lakes Huron, Erie and Ontario, the St. Lawrence and Ottawa rivers, being known as "Old Ontario", represents the section which contains the major part of the rural population and consists, in general, of an excellent, fertile, agricultural area. For the purpose of description, Old Ontario may be divided into three separate sections, in which climate plays a very important part and affects in a remarkable degree the type of agriculture conducted.

The first area to be described is that section having its northerly boundary roughly defined by a line drawn approximately from the mouth of the St. Clair river, through London to Hamilton and along the shore of Lake Ontario to Toronto. This zone is known as the "Carolinian" area in which the mean annual temperature and the average temperature for the four growing months are somewhat higher than occur in the other parts of the province, and in which the annual rainfall is also slightly greater. The Carolinian area extends in general from the northern part of the state of Florida in a northerly and westerly direction, and is known to end definitely at the Humber river at Toronto. This area contains a similarity of trees and plant life to that of Ohio, Kentucky, Virginia, the Carolinas, Georgia and northern Florida.

The Carolinian area in Ontario contains a very diversified type of agriculture. Not only is general farming conducted, but in it is most of the specialized farming, such as the growing of apples, peaches, grapes and other small fruits. Also, all the tobacco is produced in this area, and in this product alone we find the Vir-

This Map has been prepared by J. Patterson, M.A.

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ginia flue-cured type grown in practically identical quality and color to that of the states of North Carolina and West Virginia. Further, market gardening is conducted very extensively, with its allied canning industries.

The second area may be described as having its northerly limit in a line drawn approximately from the mouth of the Severn river at Georgian Bay to a point near Pembroke on the Ottawa river. This is known as the "Alleghanian" area and represents the regions between the needle-leaf forests of the north and the broad-leaf forests to the south, in many respects having characteristics similar to those found in Wisconsin, central Michigan, part of the state of New York, part of

Pennsylvania, and most of the New England states.

In this area, the type of agriculture conducted is mostly general mixed farming and dairying. Some fruit is grown, but this is more or less limited. In general, the type of farm is considerably larger than that found in the first area just described, and for that reason offers greater difficulties in distributing Hydro-electric service, as the farms are usually much further apart.

The third or "Canadian" zone lies to the north of the Alleghanian area, and in Old Ontario includes the Parry Sound and Muskoka districts. This zone also covers the great northland of Canada. As yet, only a limited amount of line has been constructed for the agriculturalist in this area, and it is not known what the future may hold in the way of distributing power to this section. An instance of this is the great clay belt of Northern Ontario which lies several hundred miles to the north of Toronto, in the vicinity of the great mining camps of Cobalt, Kirkland Lake and Timmins. This area has developed a type of farming over an extensive tract, but the problem of distributing electric power has not presented itself at this time.

Much could be said of the character of the soils in Ontario, but it is thought sufficient to say that a great portion of the province is covered by a glacial drift in which are contained many old lake bottoms, one of which is the excellent fruit-growing area of the Niagara peninsula.

In the extension of rural electric service, it is interesting to note that during the first ten years in which the development of rural took place in the province, service to a large degree, was made available in the Carolinian district on account of the fact that in this part, the density or number of consumers per mile, is much larger, and consequently facilitated making service available to a much greater extent. There is also the fact that due to the diversified type of agriculture, the financial position of the farmer in this area places him in a position to afford electric service more readily than in the general farming districts in the province. For the past few years, the mixed farming districts have been taking service at a much more accelerated rate than heretofore, due primarily to the introduction of more uses to which electric service may be applied in this type of agriculture.

The distribution of electric power to the rural sections of Ontario was undertaken, prior to 1916, in a manner whereby the Hydro-Electric Power Commission of Ontario provided the capital necessary to construct the primary or high-voltage lines only in the various townships served, the townships themselves furnishing the capital for transformers, meters, services and auxiliary equipment.

The method of charging for electric service to the farmer consisted in general of a rate containing two parts —a service charge of a fixed monthly amount to take care of the annual fixed charges on the capital required for the construction of primary lines, and a consumption rate which would bring a sufficient annual revenue to pay for the power consumed as well as the fixed charges on the capital expended for secondary equipment, together

with the annual maintenance, operation and administration. The service charge portion of the rate then in force was on the following basis:

3 consumers per mile—$3.00 per month net.

4 consumers per mile—$2.50 per month net.

5 consumers per mile—$2.00 per month net.

At the time referred to, the supplying of township communities was considered to be a municipal affair and one which necessitated contracts being entered into with the Hydro-Electric Power Commission, similar to those for urban municipalities, in which they undertook not only to pay for power at cost, but also to return any capital provided on behalf of the township municipalities by the Hydro-Electric Power Commission of Ontario in the form of an annual sinking fund, covering a period of thirty years.

Many difficulties presented themselves in giving service to rural communities in this manner, and not the least of these was the inability to secure, in most instances, but a relatively small number or group of farmers to take service, thereby tending to defeat any scheme or attempt to serve the entire municipality in a broad or comprehensive manner. Also difficulties were encountered in serving adjacent townships, where it was necessary to construct feeder lines through one municipality to serve another. This, with other problems, lead to abandonment of the scheme for one in which the Hydro-Electric Power Commission provided all the capital required for the distribution and transformation of power to farmers, and in addition, to act as trustee for the interested municipalities in the construction, financing and operation of all projects undertaken.

The first project of this character was commenced in 1920, when a monthly service charge was required to meet the annual fixed charges on the capital for primary and secondary equipment, which included interest, sinking fund and depreciation, as well as the annual operation, maintenance and administration, amounting to $6.20 per month net for each farm consumer; on the basis of securing an average of not less than three contracts per mile, the undertaking would be self-sustaining. In addition, a suitable kilowatt-hour rate was made, sufficient to pay for the power consumed, and varying for each particular locality depending on the cost of power.

Shortly after the introduction of these rates, legislation was enacted in 1921 by the Province, whereby the Government undertook to bonus rural primary lines to the extent of 50 per cent. of their cost, as an aid to agriculture. This had the effect of reducing the service charge to farm consumers from $6.20 to $5.07 per month net. There was an immediate response from agriculturalists, which necessitated construction of a very considerable mileage of rural lines, an event that really marked the beginning of the widespread of rural service throughout the province. Extensions were made under this plan until 1924, without change in the basic principle. However, in that year the Government amended the existing legislation by providing a grant-in-aid or bonus of 50 per cent. of the entire cost of both primary

lines and secondary equipment used to distribute power to agricultural communities. This brought about a lowering of the farm service charge from \$5.07 to \$4.10 per month net, and needless to say, had an immediate further stimulus in spreading rural extensions.

Many of the older rural power districts by this time had obtained a very considerable growth and were commencing to show net surpluses over and above annual operating costs, causing in many instances a substantial lowering of the rates for both service and consumption charges. As the net operating surplus in a rural power district is credited to the district which created it, it became necessary in a few years to return to the consumers a portion of the surplus, in the form of cash or credit on their bills. The popularity of rural electric service grew so rapidly, due in no small measure to the lowering of rates, that in 1930 the Legislature again passed an act, an extract from which is as follows:

> "Where such minimum service charge in the case of any rural power district is not sufficient to meet the necessary cost of service as specified by the Commission, the deficit shall be chargeable to and payable out of the consolidated revenue funds."

Among other things, it provided that the maximum service charge to be paid for farm service would not be greater than \$2.50 per month net, and if a deficit resulted from such service charge, it would be chargeable to the Province, to be paid out of the consolidated revenue.

Further reductions were made in 1936 and 1937, whereby the service charge is now at a maximum of \$1.00 per month net.

In its inception, the procedure followed to acquaint the agriculturalist with the scheme, was to hold a series of public meetings wherever requests for electric service were received. At these meetings, the complete scheme was explained in detail and in many instances moving pictures were shown of the uses of Hydro-Electric power. Committees of those interested were formed for the purpose of canvassing the various prospective consumers along the route where the proposed line was to be constructed. These committees were under the guidance of an engineer of the Commission, who was constantly at hand for the purpose of giving information to the canvassers.

In order to construct a line, the Commission required a minimum of three farm contracts per mile, and as soon as lines of the required density were contracted for, approval was obtained immediately and construction carried out. Once the original construction was undertaken, an office with a superintendent and the required staff was established in the rural power district for the purpose of carrying out the operation, construction and facilitation of further canvasses in the particular areas. The Commission has followed the personal method in obtaining new contracts since its inception, as this has proven an effective way of giving information to the rural dweller.

At the present time, rural canvassing is done almost entirely by the

rural power district superintendents and their staffs, as to a large extent they are personally acquainted with the people in their districts, both those who are taking and those who are not yet receiving electric service. This intimate knowledge enables the superintendents to forecast to a great extent, when prospective consumers may require service.

Probably one of the most effective means of popularizing electric service is that in practically every locality within the province, certain agriculturalists who are now supplied, afford an opportunity to their neighbours to see actually the benefits of electric power, thereby creating a desire, which could not be duplicated by any other means.

The Commission maintains a bureau for distributing information on new uses of electric power, in the form of printed pamphlets which from time to time are forwarded to both the user and non-user, in order that they may be kept advised of the progress being made in utilizing electric service.

The Commission at all times endeavours to give special attention to such matters as research work on new applications which are particularly adaptable to rural products. The work done to date has special reference to the development of grain grinders in such sizes and at a cost which the farmer can afford to pay. Work has also been done in assisting manufacturers to develop inexpensive and efficient milk coolers which are used primarily in the dairy industry. In recent years, a considerable amount of research has been undertaken with a view to applying

RURAL RATES

Class	1B	1C	2A	2B	3	4	5	6A	6B	7A	7B
	Monthly consumption charged for at first energy rate										
No. of kw-hrs. per month	30	30	30	30	42	70	70	126	126	210	210
	Monthly consumption charged for at second energy rate										
No. of kw-hrs. where first energy rate is: less than 3 cts.	120	270	120	270	258	430	430	774	774	1290	1290
3 cts.	105	240	105	240	228	380	380	684	684	1140	1140
3.1 to 4 cts.	75	180	75	180	168	280	280	504	504	840	840
4.1 to 5 cts.	60	150	60	150	138	230	230	414	414	690	690
more than 5 cts.	45	120	45	120	108	180	180	324	324	540	540

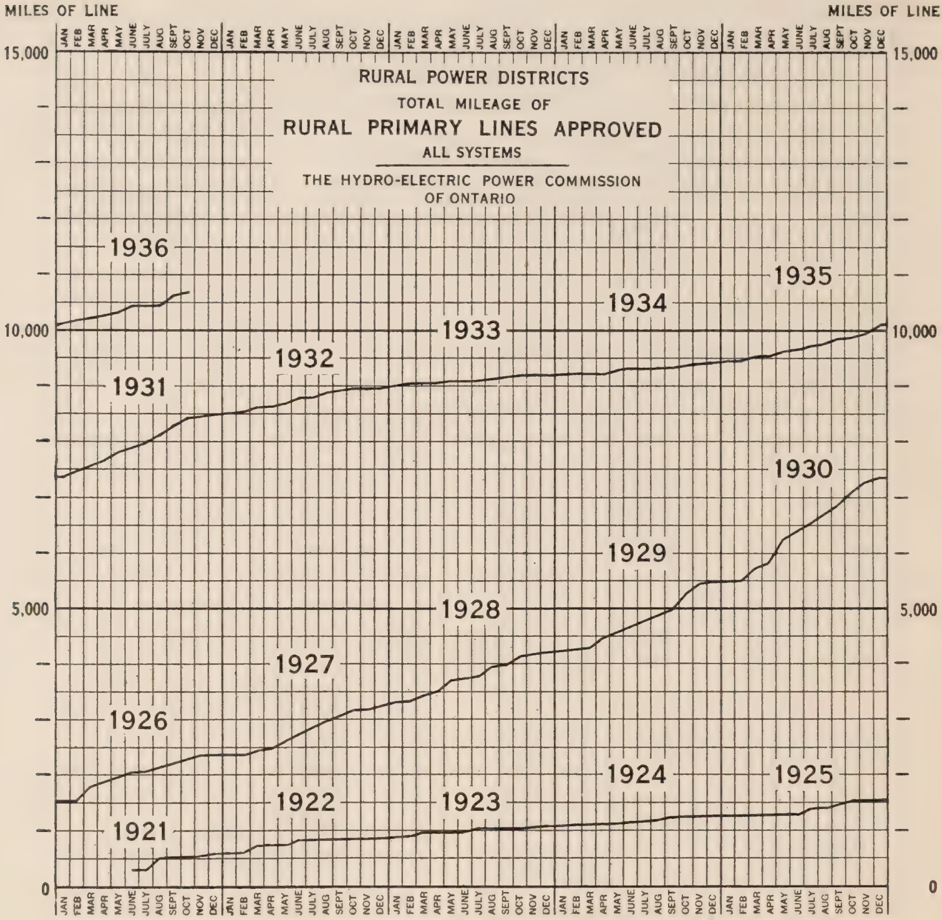

Fig. 1.

electric power to under-soil heating. This particular application is meeting with favourable results in the areas where market gardening is being conducted extensively. Engineering assistance is also given to trustee boards of rural schools with the object of installing proper and efficient lighting systems in country schoolhouses. A staff is maintained for the purpose of disseminating information in the home on proper and correct methods of illumination. Considerable work has been done in applying electric power to irrigation problems, also the most efficient method of pumping water for domestic and farm use, in order that the application of electricity to the farm may be done in the most economic manner.

An organization has been in existence for many years for the purpose of giving lectures and demonstrations on the use of electric ranges and other appliances, at Women's

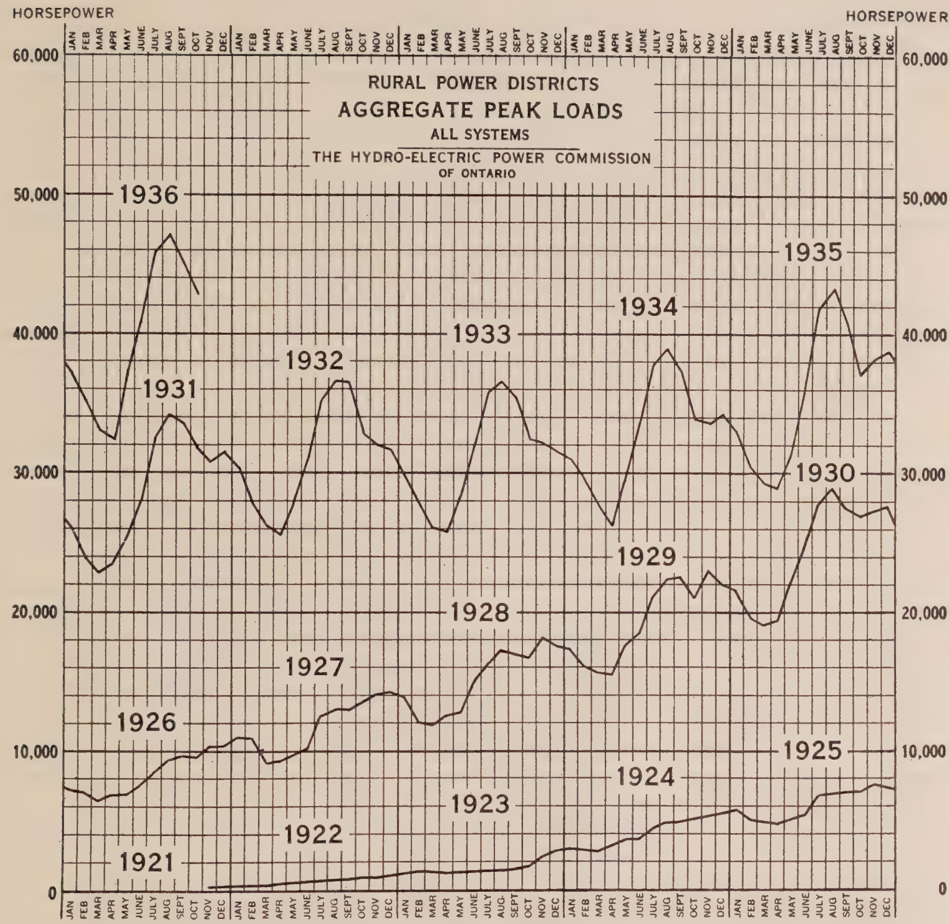

Fig. 2.

Institutes, exhibits at fall fairs and the Ontario Plowmen's Association international plowing match. This is done with the object of keeping before the public as far as possible, the most effective, efficient and proper uses of electric power on the farm.

The province of Ontario extends over a total area of approximately 400,000 square miles, but the section known as "Old Ontario" has only approximately 40,000 square miles, containing about 22,000,000 acres, of which 75 per cent. is land cleared for agricultural purposes, and having a rural population in excess of 1,100,000. There are about 65,000 farmers, and at the end of 1936 nearly one-half of these were receiving electric service. The number of rural power districts formed today is 174, which at the end of 1936 served approximately 77,000 consumers, at an estimated capital cost of over $21,000,000, involving the construction of

HAMLET SERVICE

Year	Annual Revenue	Kilowatt-hours Consumed	Number of Consumers Billed	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1928	$ 530,407.00	10,702,031	* 17,585	4.95¢	$2.51	50.7
1929	663,311.00	14,424,770	21,219	4.60	2.85	62.0
1930	757,558.00	17,815,987	25,013	4.25	2.73	64.2
1931	974,224.17	22,127,474	31,176	4.40	2.88	65.6
1932	1,075,081.03	24,654,386	33,638	4.36	2.76	63.3
1933	1,133.368.70	25,410,470	35,941	4.46	2.70	60.1
1934	1,149,876.67	27,768,460	37,466	4.14	2.61	63.0
1935	1,171,873.28	30,802,290	39,751	3.80	2.53	66.5
1936	1,239,010.83	35,666,241	43,014	3.47	2.49	71.8

FARM SERVICE

Year	Annual Revenue	Kilowatt-hours Consumed	Number of Consumers Billed	Average Cost Per Kw-hr.	Average Monthly Bill	Average Monthly Consumption Kw-hr.
1928	$ 569,007.00	10,969,828	* 9,309	5.18¢	$4.97	96.1
1929	777,736.00	16,022,842	12,605	4.85	5.85	120.8
1930	863,805.00	20,507,063	16,011	4.21	5.03	119.4
1931	1,128,554.28	25,716,141	20,796	4.39	5.11	116.4
1932	1,255,482.13	28,675,400	22,432	4.38	4.84	110.5
1933	1,309,122.96	30,062,194	23,283	4.35	4.75	109.2
1934	1,319,922.69	33,312,314	23,882	3.96	4.66	117.7
1935	1,343,222.39	37,667,453	25,357	3.57	4.55	127.5
1936	1,385,784.39	45,447,669	28,198	3.05	4.31	141.4

*It may be observed that the number of consumers reported here do not agree with those shown in the Annual Report of the Commission. This is due to the fact that Class 2A consumers are considered as Hamlet consumers in this report and as Farm consumers in the Annual Report. Furthermore, the figures given here represent consumers actually billed, whereas the Annual Report shows the number of contracts executed to the end of each Fiscal year. In many cases service is not given until the following year.

nearly 11,000 miles of distribution lines. In 1937 it is expected there will be an additional 2,300 miles of distribution lines to serve approximately 12,000 consumers, at an estimated cost of $5,000,000.

It will be noted that the Commission serves other consumers than those who are engaged in purely agricultural pursuits. There are many small hamlets scattered throughout Ontario, together with miscellaneous consumers and summer cottage areas, which are also supplied by the rural power districts.

For convenience of serving, the Commission has established the following classifications, and under these headings, any size farm or small dwelling may receive power according to requirements:

Class	Service	Phase	Volts	Fuse rating amperes (maximum)
1B	Hamlet lighting	1	110	20
1C	Hamlet lighting	1	220/110	35
2A	House lighting	1	110	20
2B	Small farm service	1	220/110	35
3	Light farm service	1	220/110	35
4	Medium farm service	1	220/110	50
5	Medium farm service	3	220/110	35
6A	Heavy farm service	1	220/110	100
6B	Heavy farm service	1&3	220/110	60
7A	Special farm service	1	220/110	According to load
7B	Special farm service	1&3	220/110	According to load

Figures 1 and 2 are charts showing the growth in miles of primary line per year since 1921, and also the maximum demand taken to supply the total rural load. It will be noted from the chart showing the peak load, that the highest peak occurs usually in the months of July and August. This is due to the fact that the Commission, as well as supplying rural consumers, has made power available to summer cottage users on the many lakes throughout the province.

While not all rural Ontario is as yet electrified, it is hoped that within a few years, the major portion of the population will be using electric service. With this object accomplished, it remains only to demonstrate and encourage the agriculturalists to use electric power to the fullest possible extent in order that the financial return to the consumer may be such that the service is not a burden, but rather an asset. It is a well-known fact that with installation of certain appliances, the financial return from their operation more than reimburses the farmer for the total expense of his electric service.

(A paper presented before the Convention of the North Atlantic Section of the American Society of Agricultural Engineers at Toronto, October 12, 13 and 14, 1937.)

Saving Lives with Light

By L. J. Schrenk, General Superintendent, Public Lighting Commission, Detroit, Michigan

THE street lighting systems now in operation in many cities, towns and villages were installed and put into service some twenty or thirty years ago. These lighting systems were designed to render a service to the public for protection against robbery and crime. Various promoters used street lighting to enhance real estate values while others used street lighting to increase sales in shopping districts. Apparently there was little need for thought over night traffic. The safety of night traffic had not become a problem.

The street lighting systems adequately answered the purpose for all concerned as vehicles moved comparatively slowly, travelling short distances on streets that were rarely crowded. The traffic conditions of today are entirely reversed, while most of the street lighting systems have remained unchanged. The universal use of faster cars and trucks travelling greater distances on crowded thoroughfares has created a necessity for providing adequate visibility at night. Under such circumstances, is it any wonder that the night automobile traffic accidents are ever increasing in spite of all the effort put forth to improve road conditions, to educate the public and to enforce traffic regulations?

From a paper presented before the Thirty-first Annual Convention of the Illuminating Engineering Society, White Sulphur Springs, West Virginia, September 27-30, 1937.

The street lighting system of yesterday provided protection for the public and displaced the lantern carried by the pedestrian and horse-drawn vehicle. The street lighting system for to-day's needs must be designed from the viewpoint of the automobile driver, for traffic safety. Automobile headlights, due to their location, direction of light, narrow beams and glare, do not provide proper visibility. This is shown by Detroit's accident experience over the past six years.

FATALITY TREND

There has been no material improvement in Detroit's street lighting since 1931, except during the latter part of the year 1936. Analyzing the traffic fatalities during this period, covering six years, one is impressed by the increasing night fatality trend, as compared with the decreasing day trend. By various means the 140 daytime automobile fatalities occurring in 1931 were gradually reduced to 104 in 1936. This is a substantial improvement in the right direction. The night automobile fatalities, however, increased from 188 in 1931 to 252 in 1936, in spite of the improvement shown during daylight hours. The average ratio of night to day automobile fatalities in 1930 and 1931 was slightly less than 1.5 to 1. This ratio has gradually increased, reaching the high figure of 2.4 to 1 for the past year, 1936.

Accident Study And Procedure

A study was made of the night accidents because of the increasing trend of night fatalities. It definitely pointed to night accident areas having a high rate of fatalities.

On nine different sections of heavily travelled thoroughfares, totalling 30 miles, it was found that during the year of 1934 and 1935, 100 automobile traffic fatalities occurred at night and 12 fatalities occurred during the day. Due to this pertinent data, funds were appropriated for the purpose of improving the lighting on these nine section of thoroughfares. After some lighting investigations and tests of conventional luminaries it was decided to write a specification for a new luminaire, embodying the following features:

1st—elimination of objectionable glare.

2nd—high utilization factor for effective lumen output on street surface.

3rd—distribution of light on the pavement to give an even pavement brightness when viewed from the driver's position.

4th—building up of the foot-candles in the middle of the street to provide adequate visibility of obstacles under heavy traffic conditions when the pavement itself is obscured almost entirely by the mass of traffic.

5th—providing sufficient specular on wet pavement.

6th—making use of all the present equipment where possible, such as poles, cables and regulating equipment.

7th—the great increase of candlepower in the horizontal planes approximate the pavement, i.e., providing relatively high illumination on vertical surfaces.

Proper visibility for the automobile driver was the prime consideration in the specification for this new luminaire.

Existing equipments did not provide sufficient candlepower at proper vertical and horizontal angles to build up adequate pavement brightness and vertical illumination for direct vision at the middle of the unusually broad streets. The high rate of night traffic fatalities as compared with the day fatalities, on wide streets, indicated this lack of adequate visibility, especially since 75 per cent. of the night fatalities were pedestrians.

The comparative high vertical foot-candle values just above the middle lanes of the street are found to greatly enhance visibility by direct discernment, especially on rainy nights. This, from the viewpoint of visibility to the driver, is highly important on heavily travelled thoroughfares, when cars are in close proximity to each other. Visibility is also greatly augmented by the excellent glint and moving shadows produced by the high intensities of light directed out from the curb and in opposite directions along the thoroughfare. Due to the excellent light distribution of the new reflector type luminaire, satisfactory visibility has been secured in relatively narrow streets with one side mounting. This is important since a large saving in investment would accrue through such an arrangement.

The effective use of light on these thoroughfares is the answer to the great reduction accomplished in night automobile fatalities.

EFFECTIVE ILLUMINATION WITH IMPROVED LIGHT DISTRIBUTION AND INCREASED ILLUMINATION

The following number of night and day fatalities occurred on a section of Gratiot Avenue, from Brush Street to Mack Avenue, after the street was widened to a distance of 90 feet from curb to curb.

Year	Night Fatalities	Day Fatalities
1933	3	1
1934	4	0
1935	5	0
*1936	2	1

*The figures for 1936 should not be considered for any comparative purposes due to the fact that the street was closed to traffic a greater part of the year to permit further widening of an adjacent section.

This section of Gratiot Avenue is 1¾ miles in length. Analyzing the above figures we find the night fatalities gradually increasing while the day fatalities remain practically the same. A study and observation of the street lighting condition pointed out the fact that the middle of the street was very dark, and sufficient pavement brightness was produced only along the curb. The luminaires in service gave, on the pavement, an average calculated foot-candle value of .44, but the illumination was very poorly distributed.

It was believed that the number of fatalities could be reduced if the lighting conditions could be corrected. The old luminaires with no light control were changed to the new type, containing scientifically designed redirective equipment, and the lamp sizes increased to 15,000 lumens. This change increased the average calculated foot-candles from .44 to 1.46. The foot-candles were materially built up in the middle of the street, producing excellent pavement brightness and correcting the poor visibility which existed with the former luminaires.

The new luminaires have been in service since the early part of January, 1937. Since that time, to July 1, 1937, or six months of service with the improved lighting on this section of Gratiot Avenue there has not been a single night fatality.

THE MOST EFFECTIVE EQUIPMENT USED IN THE MOST EFFECTIVE MANNER

A typical example of the above phrase found in the "I. E. S. Street Lighting Code" has been demonstrated by these new luminaires.

In one high-accident area of a thoroughfare 1¾ miles in length and with a width of 72 feet from curb to curb there were 9 fatalities at night in the years of 1934 and 1935 to none during the day. During the first nine months of 1936 there occurred 4 night fatalities and none during the day. The improved lighting went into service the early part of October, 1936. During the following nine months, from October 1, 1936, to June 1, 1937, the records show no automobile fatalities at night and one during the day. To accomplish these results not a single additional generative lumen was used.

The old lighting system consisted of upright luminaires mounted on 18-foot poles, 100-foot opposite spacing, 10,000-lumen lamps, with no light control. This system was changed to the new pendent luminaire with effective light control, mounting height increased to 22 feet, the same 100-foot opposite spacing, and the same size lamp, 10,000 lumens. Since no other

conditions have changed, except the traffic has increased somewhat both day and night, it is reasonable to assume from the above record that the present lighting installation now provides adequate visibility. This increased visibility has corrected a hazardous condition at night. It has provided for the automobile driver a traffic safety at night equal to that of the daylight hours at the same speed regulations.

The improved street lighting on the various sections of streets approximating thirty-one miles has been in service only from five to nine months. This must be taken into consideration when making comparisons of the fatal traffic accidents before and after improved lighting was put into service. The results however, are very gratifying. They indicate in no small way that the improved street lighting has solved the high rate of fatal accidents at night on streets where the death rate in the city was the highest.

IMPROVED STREET LIGHTING RESULTS

There were 111 night fatalities and 16 day fatalities on the 31 miles of street in the years of 1934 and 1935 under the old lighting system, resulting in a ratio of 7 to 1 between night to day automobile fatalities.

There were 35 night fatalities and 5 day fatalities on the same 31 miles of thoroughfare in 1936, before improved street lighting went into service, also a ratio of 7 to 1. Since improved lighting has been in service on these same streets, covering periods of 5 to 9 months on different sections, there have been 6 night fatalities and 5 day fatalities, or a ratio of 1.2 to 1. Had the ratio of night to day fatalities approximating 1¼ to 1 been maintained in 1934 and 1935 there could have been a potential saving of some 80 or 90 lives. In 1936, before the improved lighting went into service, the above figures indicate a possible saving of 28 lives.

On seven miles of streets, where improved lighting has been in service nine months, from September 1, 1936, to June 1, 1937, there have been only two night fatalities and two day fatalities. During the first eight months of 1936, prior to improved lighting there were ten night fatalities to one in the daytime on the same seven miles of thoroughfare. This reduced fatality rate was accomplished in the most adverse time of the year, namely during the winter months. During this period the night fatality rate far exceeds that of the summer months or the average for the year. Statistics also show that the fatality rate over the entire city was 20 per cent. higher than during the same months a year ago. These results were accomplished at a time when the automobile traffic had materially increased. The registration of cars was 20 per cent. higher in 1936 than in 1934 or 1935, and all indications point to the fact that the vehicular traffic for 1937 is still greater. It is quite evident that night traffic accidents can be materially reduced with adequate street lighting. The results show that a properly designed street lighting system will provide safety at night for the automobile driver equal to that by day, while driving at the same speeds. Thus we see "Saving Lives With Light" becomes an actuality of outstanding significance.

The Characteristics and Application of Modern Electrical Relaying

By E. M. Wood, Assistant Engineer, Electrical Engineering Department, H.E.P.C. of Ont.

(Continued from September)

The highest speed carrier pilot schemes offered, while differing in details, have the following in common:—

The carrier equipments at the termini of the protected section are each coupled to the same conductor of the transmission line, which is suitably "trapped" to retain the carrier current on the section. The sending sets, each consisting of an ordinary oscillator tube with amplifiers, are tuned to the same frequency, in the range of 50 to 150 kc. per sec. The filaments are continuously heated, but sets are prevented from generating by a negative grid bias on the oscillator tube.

In the relay equipment at each terminus is a set of sensitive non-directional relays of the impedance type for phase faults and operating on residual current for ground faults.

In case a fault anywhere on the system creates sufficient disturbance to operate any of these sensitive relays, it removes the grid bias from the respective carrier set and puts a carrier current of the correct frequency on the line which functions through receiver relays to open the trip circuit of the breakers at the terminals of the section. Carrier from one terminal of a section will lock out all the breakers of that section in a fraction of a cycle.

The generation of carrier at any terminal is stopped if fault current is flowing into the section at that point as shown by the contacting of directional relays. So long, however, as any one terminal shows fault current outflowing, indicating that the fault is external, the carrier will maintain the lock-out at all terminals and retain the section in service.

In the case of a fault in the section the directional elements at the points where the fault detectors have operated will point toward the section, removing the carrier and allowing the same or other relays to trip the circuit breakers. The relays are all of the high speed type, and the overall relay-operating time for internal faults is of the order of one to two cycles of system frequency.

In case instability or severe swing should occur on the system following the clearance of a fault so that a pilot-protected section is likely to be tripped due to the surge, it is possible to add a device which will indicate such a condition and prevent the trip-out of the line.

This type of pilot protection is the only type of high speed relaying of

general application which gives simultaneous high speed clearance at all terminals for a fault anywhere in the protected section and in which provision is available to prevent tripout of the line section on wide swings between power sources.

It may be applied to any line section of any practicable length without reference to the relaying on the remainder of the system.

The relays are sensitive and where necessary are operative on fault currents below normal load.

The application of these relays can be made effective to a much larger extent than other types on branched or tapped lines, thus allowing greater freedom in the line arrangement and often permitting imporant economies in line construction and switching. This should not, however, be taken as permitting unrestricted application to all such lines without careful investigation of each case.

Current Balance Relaying

Where two or more equal parallel circuits without taps exist between common terminal busses, high speed equipment operating on the principle that under fault conditions their currents will be unbalanced, is available. Such equipment has the advantage of simplicity. Over 60 to 70 per cent in the central section of a line it will give the fastest relay time available, of the order of one one-hundredth of a second. Being inexpensive, it is a useful supplement to other types of protection where it is applicable though the number of possible applications is limited. It is not usually subject to incorrect operation on system surges.

Instantaneous Overcurrent Relaying

In some systems where the expenditure to install impedance or pilot protective schemes is not considered warranted, or where the induction overcurrent equipment has been installed and is giving reasonably reliable service, but is considered too slow in operation, an important improvement can be made at a nominal cost by adding instantaneous overcurrent relays. For phase-to-phase these are not of universal application but may often be of assistance if set above the maximum fault current that can pass through a long line section. When used in the residual connection for single-wire or two-wire ground faults on line sections which had dead-grounded transformer neutrals at or near either terminal, they give results in many cases practically equivalent to those obtained from more expensive types.

Some Design Problems in the Application of High Speed Relaying

The successful application of relay equipment which is often so sensitive that it will operate at currents below ordinary load values in one cycle or less of system frequency requires care and judgment in the coordination of the relays to the conditions of the system to a greater extent than in the case of slower types of protection. The application for the best results must be based on sound data including the following items:—

1. A fund of information on the nature and manner of occurrence of faults on the power system and of

the behaviour of the system and of various types of relaying under fault conditions is essential and may be accumulated in the course of time from the following or other sources:—

By means of automatic recording devices which are instantly put into operation by the disturbance due to the fault and may record the transient conditions of voltage, current, power flow, sequence of circuit clearances and the like. The most useful of these is the automatic oscillograph whose records in the course of time give a very fine insight into the nature of accidental faults on a power system and the consequent behavious of the system.

By means of "staged" tests in which pre-arranged faults are placed on the system in the way to give the maximum of information, allowing observations of system quantities and behaviour to be made and recorded by automatic devices. Such tests should be made after any important relaying installation has been completed, especially if new types are involved, as they will furnish a valuable check on the correctness of the design and adjustments and will often prevent incorrect operation in service.

By means of well designed operation indicators on the relays. High speed relays are usually made of simple elements, each of which performs a single definite function in a sequence. Proper provision of indicators for each function, including timing, will furnish much valuable information.

2. The range of values of fault current and in some cases of voltage and phase angle for each of the relaying points should be available. The most satisfactory way to calculate unbalanced faults is by the method of symmetrical components. For the more complicated networks a calculating board is useful, preferable of the a.c. type; however, solutions from the d.c. board will be sufficiently accurate for most relay applications.

3. Information should be available as to the characteristics and limitations of the relays which it is proposed to use including their speed and the behaviour of the contacts over the range of currents and voltages which may be encountered in service. Freedom from chattering or rebounding of relay contacts is always important in high speed applications and is essential in some lockout pilot schemes. The burdens imposed by the relay coils in their relation to current and potential devices on which they are to be used should be known so the overal sensitivity of the equipment can be predicted.

With data of this sort available the power system engineer and the relay designer are prepared to co-operate closely to install equipment which may be expected to give the desired results.

In dealing with sensitive high speed equipment used in differential or other balanced protective schemes where secondary currents from various current transformers are compared and expected to be zero in the relay circuit for faults outside the protected element, there is a certain

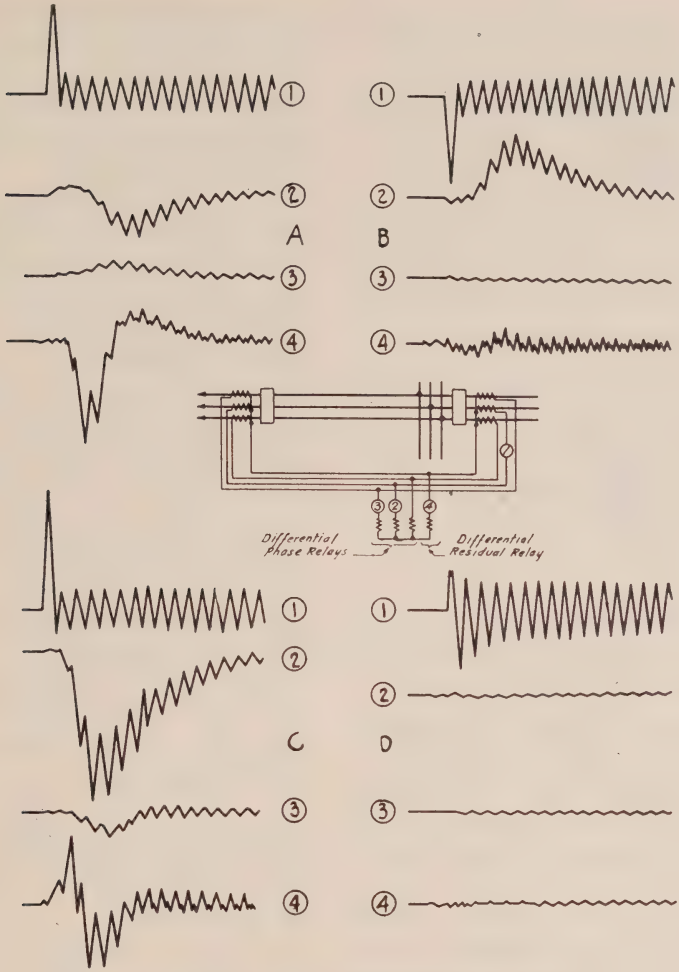

Fig. 3—Transient Differential Relay Occurrence.

possibility of improper tripping of the relays on heavy currents "through" the zone.

Figures 3 and 4 have been prepared from oscillograms taken during staged tests on a low voltage and a high voltage system respectively. They indicate that one cause of incorrect relay operation lies in the different response made by current transformers to the transient d.c. component in the primary current wave. In a large number of sensitive equipment and bus zone differential protections which have been under the observation of the author for a number of years, a few incorrect operations of zones at voltages below 15 kv. have been experienced, all for disturbances at that voltage. The author knows of only one case of incorrect operation of a bus differential for a fault on a high voltage line and in that case the fault was a metallic short circuit at the

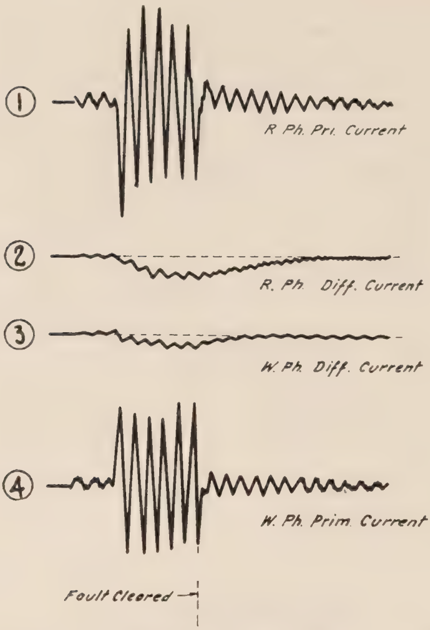

Fig. 4—Transient Differential Relay Occurrence.

terminals of the station. Presumably the tendency of high voltage faults to strike at the peak of the voltage wave keeps the d.c. component and the transient differential current at a minimum.

In Fig. 3, *A*, *B*, *C*, *D*, are taken from a series of ocsillograms of four transitions in the starting sequence of a large synchronous condenser. A number of incorrect differential relay operations had occured at times of transition from starting to running. Oscillograph elements 1, 2, 3, 4, are connected in the respective locations shown in the diagram. The following points are of interest:

The exaggerated unidirectional value of the first cycle, element 1, in *A*, *B*, and *C*. This is more severe than would occur on an accidental short-circuit.

The unidirectional nature of the differential current (element 2) for the same phase as 1. The small alternating component is probably due to slight differences in the current transformers.

The irregularity of the differential residual current in element 4.

The very small differential currents in start *D* where the asymmetry of the primary current is not so pronounced.

Figure 4 is from an oscillogram for a metallic short-circuit, wire-to-wire just outside a differentially protected station zone of a high voltage system.

Element 1—current "through" the zone in phase "*R*."

Element 2—current in the differential circuit in phase "*R*."

Element 3—current in the differential circuit in phase "*W*."

Element 4—current "through" the zone in phase "*W*."

It should be noted that the differential current in 2 does not go to zero when the fault is cleared but dies away slowly.

In designing differential schemes which must be sensitive, and at the same time be stable on heavy "through" currents, the following precautions are of assistance:—

The current transformers should be identical in characteristics over a wide range to minimize the unbalanced alternating current. They should be liberal in design with large cores and low resistance in the secondary circulating current path so that the flux and induced voltage will be low under the maximum "through" fault condition.

Tendency to trip on unbalanced a.c. components can sometimes be met by use of the percentage differential principle whereby the relay setting is a percentage of the "through" current and is automatically raised for external faults; this device does not help in case of d.c. differential components as may be seen from Fig. 4. Such components can be by-passed from the relay operating coil by a transient shunt designed to admit the direct current while forcing the alternating component through the operating coil.

For cases where these are not effective as for the irregular transient, one apparent remedy is to use the sensitive relay with slight time delay supplemented by a high speed device set above the transient unbalance.

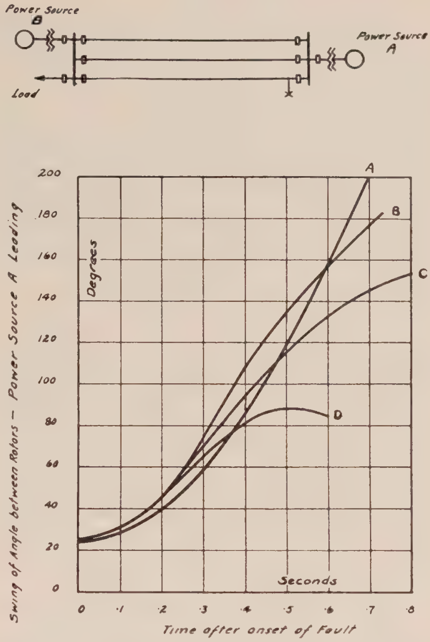

Fig. 5—Effect of Fault Clearance Time on Transient Stability of a System. Fault Location at X.—Phase to Phase to Phase.

Benefits From the Use of High Speed Protection

The criterion for the value of any relay application is the result obtained in operation. On those power systems where relays of the high speed type have been in service for a number of years the following very definite advantages have been realized:—

Damage to equipment and to structures in stations where the fault has been cleared rapidly has been negligible even with a heavy concentration of current at the point of fault. Oil fires very seldom develop.

Burning of the heavier conductors of transmission lines has been greatly reduced so that faults are often difficult to locate. There is seldom any shattering of insulators. So far as arc damage is concerned the circuit is, in a high percentage of cases, in condition to be reclosed immediately.

The operation of interconnected power sources and transmission networks is greatly improved by rapid clearance of faults. Figure 5 is drawn from a study of the effect of fault clearance times on the transient stability of a system.

A—Clearance time in 0.3 sec. at end adjacent to the fault; in 0.8 sec. at the remote end.

B—Clearance simultaneous in 0.3 sec. as by "carrier" pilot scheme.

C—Clearance in 0.2 sec. at the adjacent end and 0.5 sec. at the remote end.

D—Clearance simultaneous in 0.2 sec.

System conditions, loads and fault location are approximately constant for all.

It is to be noted that for the particular conditions of test, the system is stable if the fault is completely cleared in 0.2 sec. but not if it lasts for 0.3 sec. The gain for clearance in 0.1 sec. is also apparent.

Comparison of curves *C* and *D* shows the disadvantage in this particular set of conditions of delayed clearance at the end remote from the fault as in the stepped range impedance relaying of *C*. The requirement in this case is for simultaneous clearance at both ends as in *D*.

The increased stability permits heavier loading of interconnections.

When high speed relaying has been applied to systems arranged to take the fullest advantage of it, service outages will be very few no matter how many accidental faults occur. In any case interruptions will usually be short because the circuit can quickly be restored to service.

If faults on a system are cleared rapidly so that voltage dips are short, industrial customers can readily arrange their control equipment to enable their motors to ride through, which will go far to eliminate delays and loss of production in manufacturing operations.

High Speed Relaying and Automatic Reclosure of Circuits

There is much interest at the present time in automatic reclosure of overhead circuits immediately after a trip-out. With high speed relaying this can be done successfully in as high as 90 per cent of all cases. The equipment to control the reclosure is very simple and inexpensive. With ordinary oil circuit breakers on voltages up to 130 kv. reclosure can be made in one-half to one second after the onset of the fault if the line is completely cleared at high speed.

Standard control equipment is available which will carry induction motors through this period and in the case of synchronous motors will, if it is desirable to do so, remove the field and resynchronize the motor after pulling it into step.

It is of interest to note that while high speed relaying permits automatic reclosure with a high degree of success, the adoption of the latter permits greater freedom and simplicity in the application of high speed relaying by removing to some extent the requirements on the relays for selectivity.

The development of this combination will in the opinion of the author bring forth a major advance both in economy in system construction and in quality of service which can be rendered.

How the Planets Move

By F. K. Dalton, H.E.P.C. Laboratories

THE movements of the nine planets as they travel around the sun, and the forces which keep them in motion in their orbits, have been subjects of interest and wonder for many ages. The earlier conception of a stationary earth suggested unreasonably rapid motion in all heavenly bodies, and the theory of Ptolemy, suggested in A.D. 150 to explain the wanderings of the planets, and accepted for many centuries, was not satisfactory.

It was about the year 1540 that the first real step was taken toward a solution of these mysteries. At this time Copernicus advanced the theory that the sun was the centre of our solar system and that the planets all revolved around this central body. There still were great difficulties in explaining the apparent backward movement of Mars, Jupiter and Saturn, however, so the theory was not complete though very definitely in the right direction.

Here the names of three great scientists,—Kepler, Galileo, and Newton,—stand out very prominently in the solving of this problem by observation, experiment and mathematical calculation. These men, as it were, put the solar system in order and set forth clearly the fundamental principles underlying the movements of planets and, in fact, all other heavenly bodies.

Planetary motion evidently is movement under a central force which varies inversely as the square of the distance (d). Where this force is the attraction of gravity, it also is proportional to the product of the masses of the two bodies (m_1 and m_2) involved. Thus: Force of Gravity varies as $\frac{m_1 \times m_2}{d^2}$.

About A.D. 1600, the great Danish astronomer, Kepler, as a result of his observations and deductions, and in accordance with the Copernican theory, stated that the following laws govern the motions of the planets:—

Kepler's Laws

1. Every planet moves in an ellipse with the sun in one focus.

2. The straight line drawn from the centre of the sun to the centre of the planet sweeps out equal areas in equal times.

3. The squares of the periodic times of the several planets are proportional to the cubes of their mean distances from the sun, i.e., their periods vary as $d^{3/2}$, or $d\sqrt{d}$.

In 1610, Galileo showed that all bodies falling to earth, under the force of gravity alone, fall at the same rate, independently of their masses,—"mass" being that inherent property of a material body which gives it weight or the ability to attract, and be attracted by, another body, but mass also gives the body inertia, or resistance to change of motion. Galileo therefore proved that it is not force alone, nor weight alone, which determines the motion of a body but that it is the force in relation to the inertia of that body.

Weight then is a feature depending upon both the mass of a body and its proximity to the earth, or to some other body. Inertia, on the other hand, is a property inherent in a body itself and not in any way dependent upon the position of that body in relation to other bodies.

Newton, in 1687, published his famous axioms, or Laws of Motion, which explain further the relationship between force and resultant motion of physical bodies.

Newton's Laws of Motion

1. Every body will continue in its state of rest, or of uniform motion in a straight line, unless acted upon by some impressed force.

2. When a body is acted upon by a motive force, the change of motion is proportional to both the magnitude of the impressed force and the time during which this force is applied, and takes place along the straight line in which the force is impressed.

3. Action and reaction are always equal and opposite,—i.e. when a body acts upon, or attracts a second body, that second body reacts with equal force but in opposite direction upon the first body.

Applying these laws to his astronomical observations, Newton discovered and announced that the force of gravity, — attraction between material bodies,—was the only force necessary to keep the planets moving in their elliptical orbits while revolving around the sun. Applied to celestial bodies, these are axioms, not laws, since their truth cannot be proven but they are founded upon evidence very much in their favor for in every case in which they have been adopted as the basis for calculation, the results derived have checked closely with actual observation.

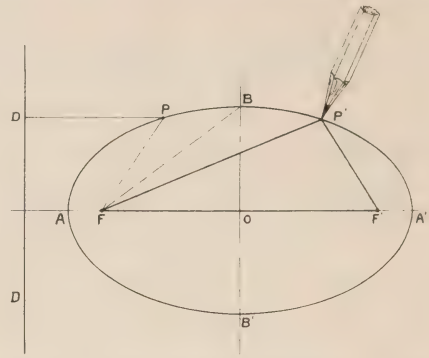

Fig. 1—Elementary Relations of the Ellipse.

$$Eccentricity,\ e = \frac{PF}{PD} = \frac{OF}{OA}$$

$FB = OA$

$FP' + F'\,P' = constant.$

THE ELLIPSE

An ellipse is a familiar figure. It is defined as the path traced by a point which moves so that its distance from a fixed point, the focus, F, is always in a definite ratio, less than unity, to its distance from a certain straight line, D, called the directrix, Fig. 1. This ratio of distances is known as the "eccentricity" of the ellipse : the longest and shortest diameters are, respectively, the major and minor axes.

There is a very simple means of drawing an ellipse with string and pencil, placing pins at the two foci, where shown, and having the loop of string the correct length, i.e. F-P'-F'-F. It is not difficult in this way to draw an ellipse with any given length of major or minor axis, or with any desired eccentricity.

Referring to the definition given here for an ellipse, if the eccentricity

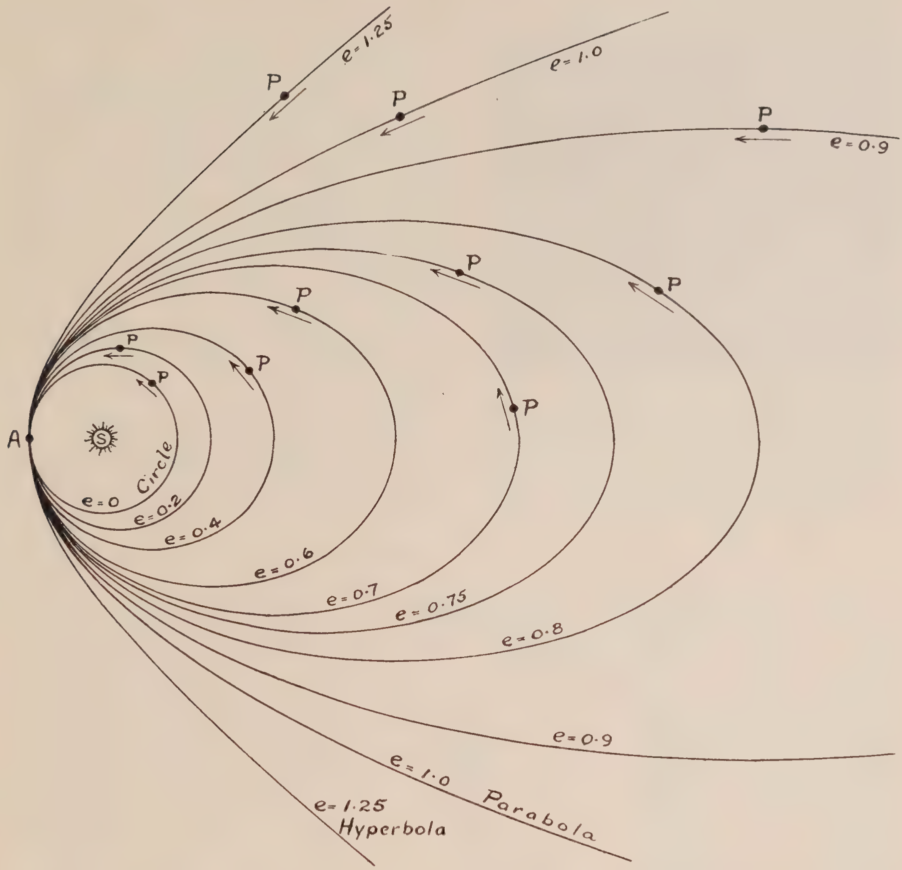

Fig. 2—Elliptical and other Orbits according to their Eccentricities. The shape of the orbit is a function of the velocity and direction of motion of the planet, or other body, at any point.

be increased to unity, the curve is not then an ellipse but is known as a parabola, and if greater than unity, it is a hyperbola. These curves are not closed figures as is the ellipse.

THE INFLUENCE OF THE CENTRAL FORCE

The movement of a planet on its orbit around the sun, and also the movements of satellites, comets and meteors, are governed by the same universal laws. These possibly may be more clearly understood by reference to Fig. 2.

Consider any elliptical orbit, the planet, P, is moving with some definite velocity and in the direction shown, tangent to its orbit. The attraction of gravity between this planet and the Sun, S, located at one of the foci of the orbit, acts while the planet moves and causes it to change direction, gradually curving towards and coming nearer to the sun. This force,

however, also causes the planet to accelerate so that by the time it has reached its perihelion, A, the position nearest to the sun, it is travelling so fast that it passes the sun at this distance without turning in to it. After the planet passes the point, A, the force of gravity acts as a deterrent to its motion, gradually slowing it down but still causing it to follow a curved path, with the result that the incoming and outward paths are symmetrical. The orbit thus becomes a complete ellipse and at all times the force between the sun and planet is inversely proportional to the square of the direct distance between these two bodies. Velocity and direction of motion are changing continually but at all times both bear definite relations to the position of the planet in its orbit.

A planet cannot be drawn into the sun for it has motion of revolution around that central body. The nearer it is to the sun, the greater is the planet's velocity. On the other hand, a planet cannot fly away into space for the attraction between it and the sun prevents this; as it moves farther from the sun, it slows down gradually curving around to return.

To prove mathematically that a planet is in a perfectly stable condition when revolving around the sun in an elliptical orbit, with gravity only as the attractive force, is a comparatively simple exercise in calculus. However, no direct method of calculating accurately the length of a planet's path—i.e. the circumference or arc of an ellipse,—has yet been found.

The nine planets of our solar system have characteristics as shown in the following table:—

THE PLANETS

Planet	Diameter at Equator Miles	Mean Distance from Sun Millions of Miles	Period of Revolution	Eccentricity of Orbit
Mercury	3,000	36.0	88 Days	0.2056
Venus	7,570	67.2	225 "	0.0068
Earth	7,927	92.9	365¼ "	0.0167
Mars	4,200	141.5	687 "	0.0933
Jupiter	88,700	483.3	11.86 Years	0.0484
Saturn	75,100	886.1	29.46 "	0.0558
Uranus	30,900	1,783	84.02 "	0.0471
Neptune	32,900	2,793	164.79 "	0.0086
Pluto	4,000?	3,678	248.43 "	0.2486

THE SHAPE OF THE ORBIT

The velocity that a planet will have at the point, A, is a function of its velocity and direction of motion at any other point on its orbit and, conversely, its velocity at A determines the orbit on which it will travel,—and also the velocity at any other point on that orbit. Thus, if a planet be revolving around the sun in a circular orbit, its velocity at A may be taken as the unit of speed. Another planet passing A at a lesser velocity would curve inwards and come closer to the sun following an

elliptical orbit. On the other hand, a planet with a slightly greater velocity would travel in a larger ellipse, with A as the perihelion of its orbit, the point nearest to the sun. The faster it travelled in passing A, the longer would be the ellipse and also the longer the period until the planet's return to the point A.

If the speed at A be as great as 1.414 units, the body would travel in a parabolic orbit and would not return. At greater velocities, the orbit would be a hyperbola and in every such case the body would not return to A. Some comets travel in parabolic orbits, others in hyperbolic orbits, but these are not periodic,—these comets are not known to return unless their orbits are later altered, and become elliptical, due to the attraction of a planet.

Relative velocities at A, and corresponding eccentricities of orbits may be found from the following formula and Table:—

$$v = \sqrt{1 + e} \text{ or } e = v^2 - 1$$

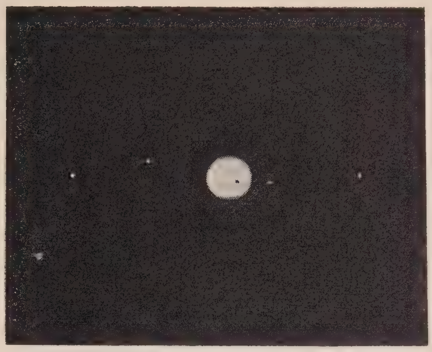

Fig. 3—There is a definite relation between the periods of Jupiter's satellites and their distance from the planet. As each satellite moves in front of the planet it casts a shadow as shown,—a solar eclipse.

Orbit	Eccentricity e	Velocity at A v	Length of Major Axis
Circular	0	1.00 (unit)	1.00 (unit)
Elliptical	0.2	1.095	1.25
"	0.4	1.18	1.66
"	0.6	1.265	2.50
"	0.8	1.34	5.00
"	0.9	1.38	10.00
Parabolic	1.0	1.414	Infinity
Hyperbolic	1.25	1.50	"
"	1.50	1.58	"
"	2.0	1.73	"

Satellites revolve around their primary planets with periods in exact relation to their mean distances from their planet. Thus Jupiter's four visible satellites, Fig. 3, are observed to move in periods corresponding to their distances, and Saturn's rings, Fig. 4, composed of many moonlets, revolve around their planet with periods in accordance with those of this planet's own individual satellites.

CALCULATING MASSES AND DISTANCES

As Newton showed with falling bodies, movement is a function of force of gravity and inertia combined, both of which are proportional to mass. A planet's path therefore is not determined by its own mass but by the mass and distance of the sun. From

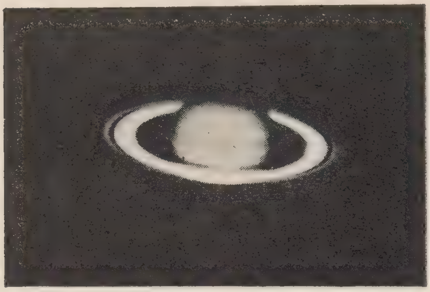

Fig. 4—Saturn's rings are composed of myriads of moonlets which revolve about the planet in periods corresponding to those of the individual satellites.—Yerkes Observatory.

this it follows that the mean distance of a planet from the sun may be calculated from the former's period alone, —i.e. the length of its "year". The mass of a planet, however, may be determined from the observed mean distance and period of revolution of any one of its satellites.

Planetary Perturbations

As every body attracts every other body in the Universe, it necessarily follows that the planets have attraction for each other and disturb one another in their motions. These variations of a planet in speed, or direction, are called "perturbations" and are sufficiently large to measure when planets are in certain parts of their orbits. As one planet approaches another, it accelerates while the other is retarded but after passing each other there is a reversal of these speed changes and the resultant effects on the periods of the planets are very small, probably negligible. It was just these perturbations in the movements of Uranus, however, that brought about the discoveries of two new planets,—Neptune in 1846, and Pluto in 1930.

Attraction of, and for Jupiter, and also of Saturn, caused some comets to alter appreciably their orbits and to change their periods accordingly. These comets passed close to one or other of these planets.

Action and Reaction

By Newton's third law, to every action there is a reaction, equal but opposite, so while a planet has its course determined by attraction toward the sun, it also is causing the sun to move in a path of the same shape as its own but smaller. The sun, therefore, is under the influence of all planets, satellites, comets, etc., and actually must follow a course determined by the resultant of these forces. The sun's mass is so great in comparison with the other bodies, however, that its orbit is of very small dimensions.

Stability

While the stability of a single planet in an elliptical orbit may easily be shown, the solar system, with its complicated attractive forces of one sun, nine planets, twenty-seven satellites, about two thousand asteroids and innumerable comets and meteors, has never been proven to be absolutely stable but its great age indicates that it is essentially so and will continue intact for many long ages to come.

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Investigation and Analysis of High Tension Bushing Faults

By Gordon B. Tebo, Testing Engineer, H.E.P.C. of Ontario

The problem of maintaining service on the transmission and distribution lines over which electric power is supplied to customers involves many very complex features. Failure on the part of some pieces of apparatus may not be a serious matter, while failure of other apparatus may result in incalculable damage to other equipment in the vicinity and possibly to personnel and result in power interruption of considerable duration.

Probably no single piece of equipment contains so much latent power of damage as the bushings of oil-breakers and transformers. Hence the interest in the serviceability of this piece of apparatus is far beyond the actual money value invested in the individual units.

Various methods have been used in the past in an endeavour to determine what factor of safety might still exist in these insulators. Advances have been made in instruments and technique and with the fullest co-operation of all departments interested in the problem, a very practical and economical method of test has been developed.

THE inability of ordinary maintenance methods to prevent failure of bushings has been apparent for some time. During the summer of 1936, so much trouble was experienced with bushings that the Insulation Research Committee of The H.E.P.C. commenced an investigation of bushing faults for the purpose of determining causes of failure and devising means of reducing failures of bushings in service to a minimum. In this Committee were pooled the accumulated experiences of the engineering and operating departments, together with

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Paper presented before Toronto Section A.I.E.E. on October 29, 1937.

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NOVEMBER, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

the testing facilities and personnel of the laboratory.

VISUAL INSPECTION INSUFFICIENT

Maintenance of bushings, until recent years, was almost entirely dependent on visual inspection. Such faults as cracked porcelains, leaking compound or oil, carbonization of visible fibre or other organic insulation, are in some cases detectable visually. Any unusual noise or hissing within the bushing may indicate development of a fault. Some bushings have been found abnormally warm prior to failure. In other cases, radio interference has been traced to bushing faults. But, in spite of the most careful inspection schedules, bushings continued to fail. Acknowledging the inability of visual inspection to prevent failures, attention was turned to some means of *measuring* the insulating value of bushings, and the most readily available instrument was the Megger.

USE OF THE MEGGER

The wide variety of work which is done, and done well, by the Megger has led at times to the mistaken idea that the Megger "Infinity" guarantees an insulation to be free of faults.

It should be understood that the Megger measures one quantity and one only—insulation resistance. As applied to low-voltage machine windings, etc., insulation resistance may be a proper measure of its quality. If used on low-voltage equipment of the 110 to 550-volt class, the 1,000 or 2,000 volt Megger test also tests the dielectric strength.

If, however, the Megger test is applied to a high-voltage bushing, especially of the condenser type, insulation resistance has very little significance. If even one of the many series layers of such a bushing is in good condition, all the rest might be wet, carbonized or otherwise damaged and the Megger would not show any leakage.

Maintenance departments for many years have supplemented visual tests on bushings with periodic Megger tests, but bushings which Meggered "Infinity" would fail without warning, again contributing to the uneasiness of those responsible for bushing maintenance.

Power-Factor Tests

One obvious defect of the Megger test for bushings, is its inability to detect leakage paths before they become *continuous* between the line and ground electrodes. This defect may be in part overcome by the use of an a.c. test voltage for measurement of capacity and power-factor. This proved of great value in the manufacture of high-voltage cable and bushings, etc., to ensure thorough drying of insulations during factory processes.

The advantage of the power-factor test over the Megger test is stated very concisely in a recent report of the C.E.A. on bushings which reads: "The Megger merely reads the sum of the resistances of all insulations in series, while the power-factor method measures the sum of the losses of the insulations".

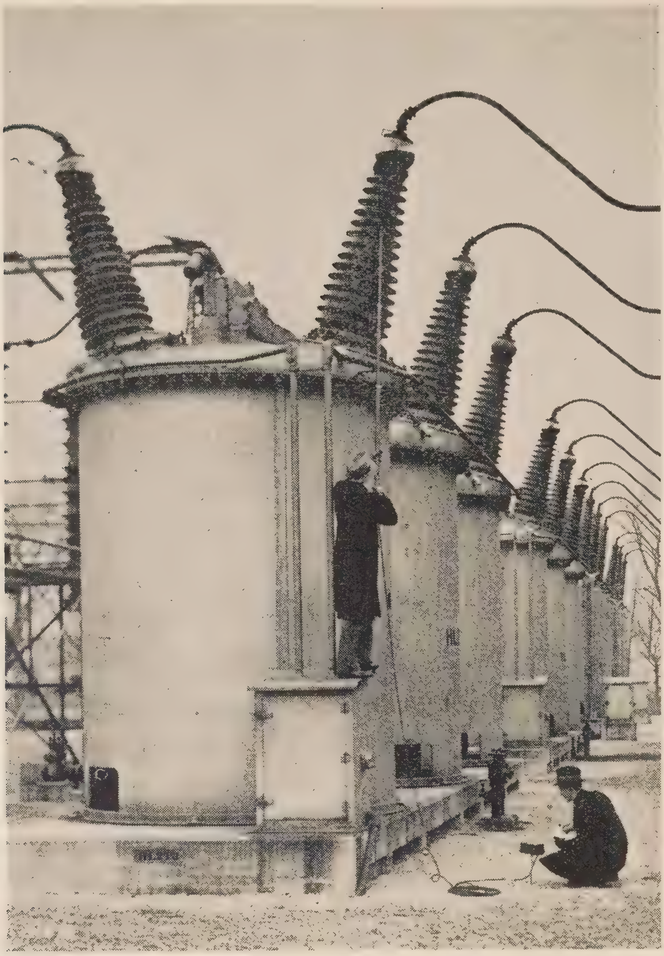
In the absence of other satisfactory test methods, the logical procedure was to attempt to apply the power-factor test in the field and, to that end, several types of equipment have been designed. These portable test sets measure power-factor and capacity, or watts loss and charging current, usually at 10 kv., 60 cycles.

Difficulty of Interpreting Power-Factor Test Results

The power-factor method of testing bushings has enjoyed much publicity in the last few years and numerous articles have described the favourable results achieved in the United States. Without commenting further on these results, I shall point out some of the difficulties which led us to seek an improved means of testing bushings. The difficulties were not due to any inability of the testing apparatus to measure power-factor accurately. The equipments used for field tests are able to read bushing power-factor to the nearest 1/10 of 1 per cent., which is quite a satisfactory degree of accuracy. The real difficulties appeared to be rather in determining from the readings whether or not a bushing was really hazardous.

While our experience with power-factor tests on bushings is rather limited, there are certain cases which indicate that a test of power-factor and capacity alone may be misleading. For instance, a 220 kv. condenser-type bushing at our Leaside Station showed a power-factor of 20 per cent., or about ten times the normal value. Based upon the limiting safe values of power-factor as published by several operating companies, this bushing should have been removed from service at once. It is now a year and a half since the high power-factor was first noted, and yet the bushing continues to operate satisfactorily in 220 kv. service. If we were obtaining this increased life of the bushings at the expense of operating safety, it would be of very doubtful economic value. But, by means of other tests supplementary to the power-factor test, it has been determined that the energy losses causing the high power-factor are so distributed throughout the bushing that its strength is not appreciably reduced. These supplementary tests will be described later.

Another interesting bushing fault was found in a 110 kv. indoor-type condenser bushing at our Cooksville

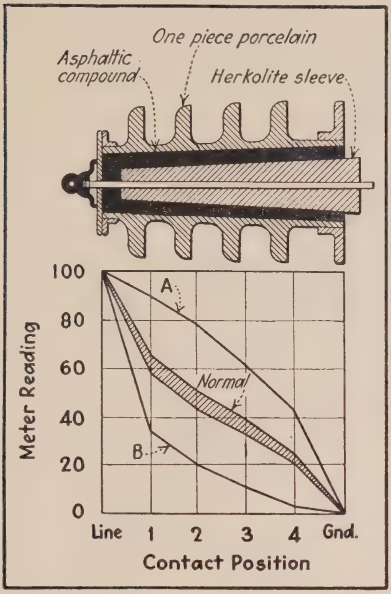


Apparatus measures gradient on 220 kv. oil-filled circuit breaker bushing.

Station. This bushing was of the so-called "torpedo-type", which is a condenser bushing without the customary porcelain rain shield or compound filling. It consists of 32 series layers of insulation and derives its name from the characteristic taper at each end of the bushing producing the shape of a torpedo.

Tests in place with full line to ground voltage on the bushing showed nearly one-third of the total layers of the bushing to be short-circuited, and full line potential to be carried by the remaining two-thirds of the layers.

The bushing was removed and brought to the laboratory for further examination. It was set up and with a test voltage of 13 kv. applied, our tests showed all layers of the bushing to be normal. It was only after



Gradient curves disclose location of leakage paths in 26 kv. bushings: (a) moisture in upper end of bushing; (b) moisture in lower end of bushing.

some experimenting that we discovered the nature of the fault which had been indicated by the field tests. It was eventually shown that 11 of the 32 layers of the bushing had at some time been punctured, either by lightning or by some crack or other defect in the bushing. The puncture was apparently clean and free of moisture or carbon, so that for voltages up to about 50 kv. the bushing behaved normally, but, at that voltage, the defective layers broke down. It is evident that a power-factor test at 10 kv. would fail to detect such a fault.

Other cases could be cited where a power-factor test indicated removal of bushings, which, while not perfect, were capable of giving years of satisfactory service.

Live Line Test Advantageous

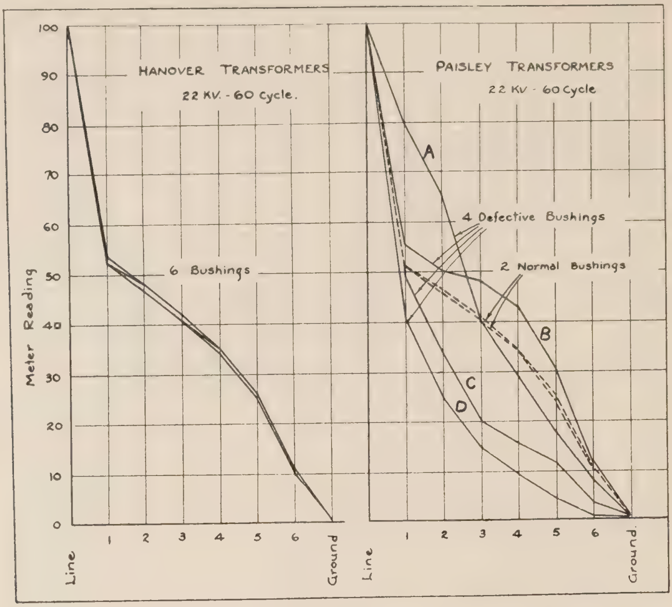
Apart entirely from these difficulties in interpretation of power-factor tests, there exists another difficulty which is increasing in importance, due to the demand for uninterrupted power supply. I refer to the difficulty of obtaining interruptions on important equipment and the complicated operating routine necessary to free all high-voltage equipment at a station for test.

It was with these difficulties in mind that an alternative test method was sought. The advantage of any method capable of testing bushings without interruption to service led at once to a survey of the methods in use for live line insulator testing, and it was soon found that much in the way of testing equipment and technique could be adopted from that art.

It has been common practice for many years to test suspension or pin-type insulators with the line alive. This is accomplished with a variety of test instruments ranging from the earlier "buzz-sticks", spark gaps, Neon lights, etc., to the more modern meter equipments, but all methods make use of the same fundamental fact that any fault in an insulating structure disturbs the normal *potential gradient.*

Application of Potential Gradient Test to Bushings

It is fairly evident that in a condenser bushing consisting of many series of layers of insulation, a leakage path across any layer or group of layers will alter the distribution of potential, throwing additional stress on the remaining good layers.

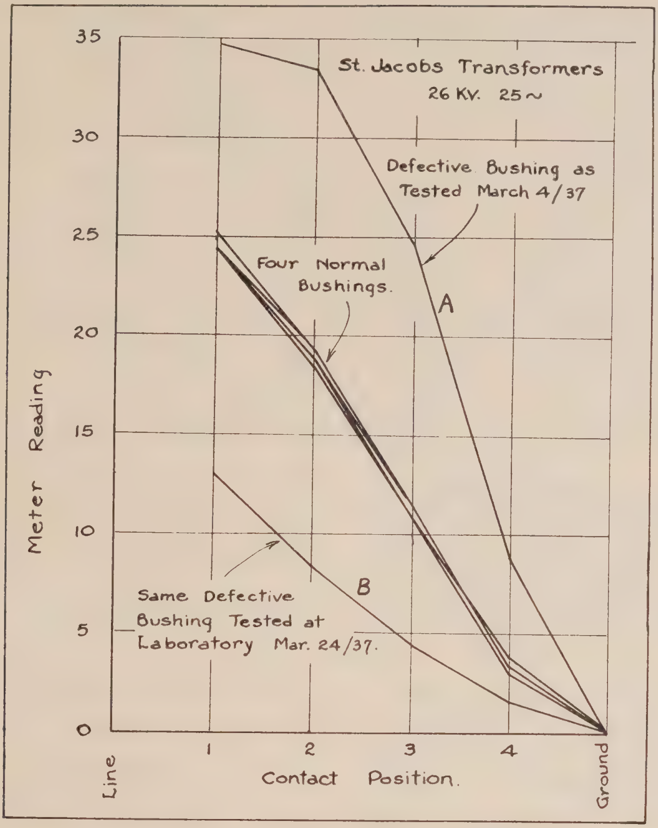


Defective bushing curves at Paisley contrasted with test results on similar transformer bank at Hanover: A—upper gasket had admitted water to upper end; B—failed on test at 110 kv.; C—failed in service after testing; D—lower gasket had admitted water—failed on test at 30 kv.

This method then appeared to have possibilities for testing bushings alive, and it remained for actual field experience to show whether or not reliable gradient readings could be obtained and satisfactorily interpreted.

The first part of the problem was to develop equipment and technique for obtaining reliable readings of potential gradient on bushings, regardless of their surroundings.

The testing device adopted for this purpose is essentially an a.c. voltmeter of such high sensitivity that voltage conditions in the insulation being tested are affected very little by its presence. It consists of an insulating handle enclosing resistor units capable of withstanding line-to-ground voltage. A lead from the handle section of the stick is connected through a sensitive a.c. meter to ground. The procedure in testing bushings is similar to that used for suspension or pin-type insulators. With the "stick" contacting the live line, meter sensitivity is adjusted to give a full scale reading, marked "100 per cent line voltage." Readings are then taken at a series of contact points on the insulator or bushing between line and ground, and these readings may be plotted to show the potential gradient over the insulator. In testing bushings, it was found desirable to make contact on the bushing by means of a semi-circular metal spring which clips around the porcelain between petticoats. This provides a uniform coupling at each contact point, and

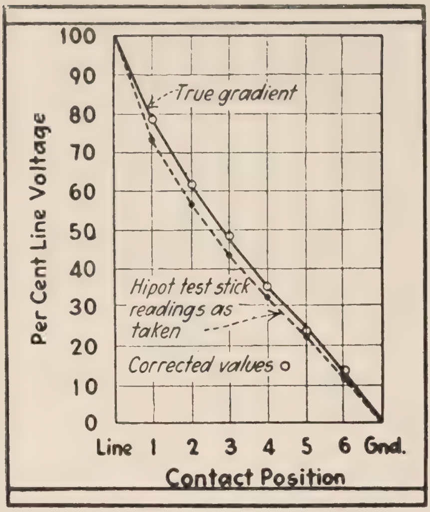


Travel of moisture from upper end to lower end of bushing, indicated by shift from curve A to curve B.

eliminates the irregularities in the curves obtained by using point contacts on cement between porcelain sections.

Actual field tests on bushings by this method were begun by the Hydro-Electric Power Commission a little over a year ago. In the first few months, our methods were of an exploratory nature, to determine the possibilities of the scheme. The simple technique of taking a set of potential gradient readings on a bushing is the result of a great deal of development work, and modification and refinement of the testing apparatus. It soon became evident, however, that the scheme had real merit and was quite workable in field tests.

The Hipot test stick readings show a regular deviation from the actual values due to the current shunted to ground through the test stick. These may be converted to actual values by a calculated correction factor. The points marked zero are the corrected values for the seven-unit string, and show close agreement with the true



Live line tester shows 60-kv., 60-cycle voltage distribution over seven-unit suspension string.

curve obtained by sphere gap, potentiometer or other elaborate method suitable only for laboratory tests. For the detection of faulty sections in insulators or comparing curves obtained on similar bushings, it is generally not necessary to make such corrections.

As soon as the weather became suitable, about April of this year, a start was made on a systematic check of all bushings—13 kv., 26 kv., 45 kv., 110 kv. and 220 kv. equipment in the Niagara System. Up to the present time, we have tested about 1,500 bushings, of which about 60 showed defects.

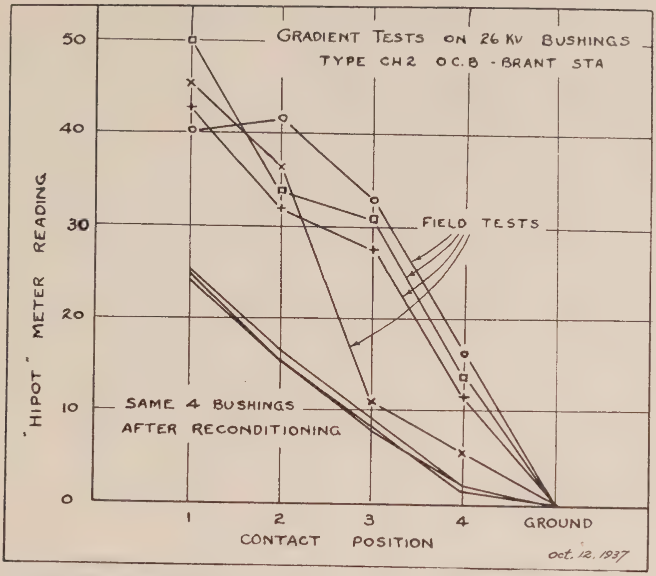
Bushing Faults Analyzed

Each defective bushing removed from service was made available for further tests at the laboratory, so that the faults could be analyzed and correlated with the field readings.

A large proportion of the faults analyzed has resulted from inability to make gasketed joints which would remain permanently watertight under the severe duty of extreme changes in temperature and pressure encountered in bushings. Gaskets appear to fail from two general causes: First, the gasket materials may flow and, unless some means is provided to maintain pressure, the joint becomes loose. The second cause lies in the actual disintegration of the gasket material, especially when the edge is exposed to the weather. Most of the faulty bushings examined in this investigation were equipped with cork gaskets. These, after five to ten years of service, were found in some cases to consist of loose granules of cork, the original binder having completely disappeared.

The present trend is toward gaskets of synthetic oil-resisting rubber with which it is hoped to attain both greater resilience and improved weathering ability. Where cork gaskets are used, it is now customary to machine and grind both metal and porcelain surfaces, to maintain pressure on the gasket by means of a compression follow-up spring and to protect the outer edges from the weather.

There is some conflict of opinion concerning the formation of carbon paths within bushings, and there is not yet sufficient evidence to be dogmatic in discussing this point. It is well known that, if the potential gradient or stress exceeds a certain value over the surface of an organic insulation (such as micarta or herkolite), an electric discharge may start at one terminal and slowly progress over the surface along a zig-zag route to the other terminal.



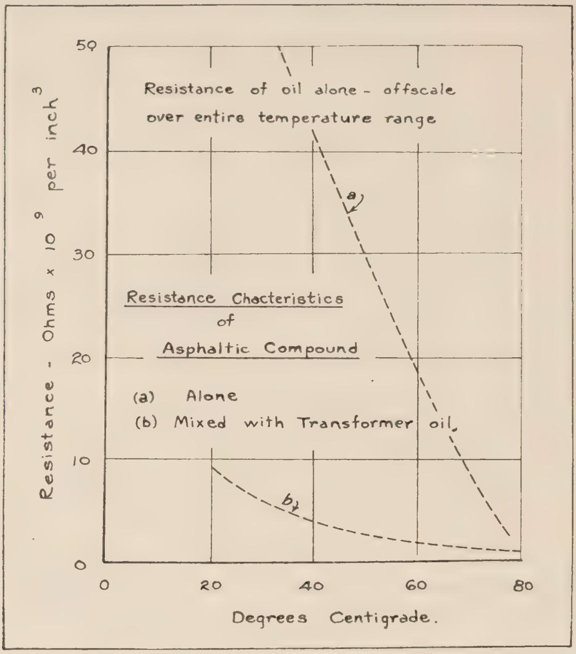
Gradient curves restored to normal by melting out compound, baking the core and refilling with new compound.

In cables and bushings of the higher voltage classes where the stress per unit thickness is very high, the phenomenon known as "treeing" may result in the growth of tree-like formations of carbon throughout the insulation.

In the case of bushings operating at 40 kv. or lower, the normal stresses appear to be well below the values at which carbonization takes place. There are, however, possibilities of *abnormal* stresses and chief among these is the condition where a considerable portion of a bushing has become short-circuited due to the presence of moisture. The additional stress thrown on the remaining dry insulation may be sufficient to start carbonization.

On opening compound-filled bushings, it is frequently found that oil has been admitted to the interior of the bushing, either through leaks at the flange or by capillary action through the main insulation. The combination of oil migration with thermal changes in the bushing can readily account for excessive pressures. The thermal expansion of the compound filling of bushings is usually taken up by an air cushion at the top of the bushing, but, if during cold periods this air space should be filled with oil, the first heating cycle will probably force out the gasket to make way for the expanding compound.

Some bushings continually drip an oil-compound mixture from the cap, and, apart from an occasional cleaning of the porcelain, operate for years without attention. Others, however, appear to breathe in moisture through the defective gasket and quickly become hazardous due to the rapid travel of the moisture through the



Migration of oil into compound-filled bushings lowers insulation resistance.

fairly liquid oil-compound mixture.

An interesting feature of this mixture of an asphaltic compound and an insulating oil is that the electrical properties of the resulting combination are very different from those of either oil or compound separately.

The lowered insulation resistance of a bushing containing an oil-compound mixture often results in a low Megger reading and in a considerable increase in power-factor. The potential gradient may or may not be disturbed, depending upon whether or not the mixture is fairly well distributed throughout the length of the bushing or confined to pockets in the compound.

This paper has attempted to outline the various test methods available for detecting faults in bushings, to describe the potential gradient method with which we have been working, and to present some typical cases of bushing faults encountered.

The investigation was not primarily intended to extend the knowledge of fundamental properties of insulations, but rather to provide an immediate and effective cure for the epidemic of bushing failures which accompanied each lightning storm or heat wave. We point with some satisfaction to the record of 1937, in which not one of the 1,500 bushings testing "normal" failed in service. The previous year's records show approximately 20 failures in the same group.

Grain Grinding

By N. E. Macpherson, B.A.Sc., Assistant Engineer, Municipal Engineering Dept., Hydro-Electric Power Commission of Ontario

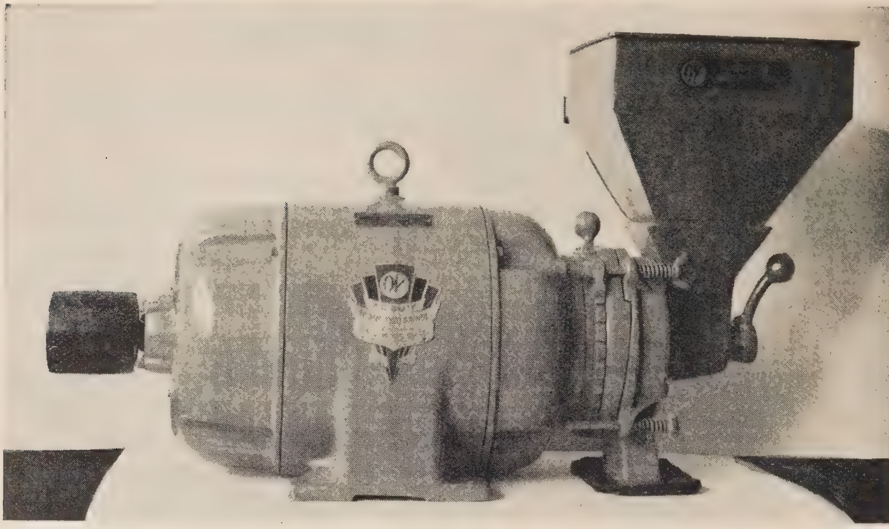
DURING the early development of rural electric service, efforts were made to encourage farmers to use electric power for grinding their own grain. It was evident that such a practice would effect substantial savings in cost and eliminate much of the time spent in bagging and hauling grain to the nearest mill. These efforts met with little success, as the equipment then available required motors of at least 5 horsepower capacity, and the cost, including the motor, proved more than the majority of our consumers would consider.

Tests on these early grinders indicated excessive power consumption and generally unsatisfactory operation, many of them requiring constant attention while operating. It was evident, therefore, that if small grinders were to be widely acceptable, radical changes in the equipment were necessary. It was the opinion of the Commission's engineers that a small grinder of 1.5 to 2-horsepower capacity of improved mechanical construction, automatic in operation, and provided with a power take-off, could be produced at a reasonable cost and meet with general acceptance.

Efforts were made to interest manufacturers in the construction of such a machine, but without success until 1929, when one manufacturer co-operated with the Commission in a series of tests made for the purpose of determining the various factors affecting the grinding of grain, and to obtain data on the output which could be expected from the small grinder.

Tests were continued in the Commission's laboratory, the results of which were briefly as follows. Fineness of the product was found to depend largely on the sharpness, adjustment and design of the plates. It was evident the existing plates would produce a satisfactory fineness when sharp, but rapidly lost this ability. Increase in speed of the plates and the rate of feeding was found to produce a somewhat finer product, but necessitated a larger motor and increased cost of the unit. The rate of grinding for a given-sized motor was determined largely by the fineness of grinding, there being a ratio of from 3 or 4 to one in output between coarse and fine. The condition of the plates and the kind and condition of the grain were also factors; grain which was well filled being easier to grind than light grain.

As a result of this work, a suggested design for a small grinder was developed, incorporating the following features—a 1.5 or 2-horsepower motor, direct-connected to a grinding head, to take 6-inch plates, the head being designed to prevent the plates from coming in contact should the flow of grain fail. The stationary plate was spring-loaded to permit the plates to separate and pass small hard objects without damaging the machine. The rate of feed of grain to



The Wood's grain grinder using $1\frac{1}{2}$ h.p. motor, one type of machine available.

the plates was controlled by a worm which had been found necessary in order to limit the power requirements to within safe values for the motor.

In 1930, a company was organized and produced a unit incorporating the above features. This was a horizontal machine with a grinding head built into one end bell of the motor, and having a capacity of 1.5 horsepower, 25 cycles, 1,450 rev. per min., and 2 horsepower, 60 cycles, 1,750 rev. per min. The power take-off was provided by a pulley at the opposite end of the motor to the grinding head. Later, another firm produced a vertical machine. In this case the power take-off was provided through a cone and bevelled disc at reduced speed, which could be disconnected when the power take-off was not required. A third unit was also available driven by "V" belts to accommodate those customers already having 1.5, 2, 3 or 5-horsepower motors, the increased grinding capacity in this case being obtained by increasing the plate speed to suit the motor being used. Two other units utilizing shaker screens, were also available. All these units used plates of 6 inches diameter.

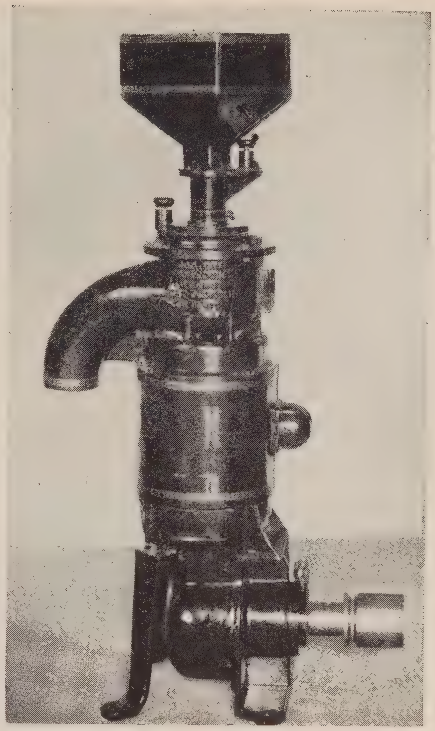
Machines are available, therefore, to meet a wide range of requirements. When introducing these machines to the public, considerable sales resistance was evident, due to the opinion widely held that grinding required relatively large motor capacity. This condition was met largely by the Commission and manufacturers arranging for demonstrations of the equipment on farms throughout our rural districts.

The cost of operating these units, of course, depends on the fineness of grinding, the kind and condition of grain, as well as the condition of the plates. Average figures, therefore,

only can be given. Based on our second rate of 2 cents per kilowatt-hour, coarse grinding varies from one-half to one cent per hundredweight; medium grinding from one to two cents, and fine grinding from two to three cents. The rates for mill grinding vary from six to ten cents, with an average of approximately seven cents. Thus, it is possible to effect cash savings of from four to six cents per hundredweight with these units, and in addition make substantial savings in labour in bagging and hauling the grain to the custom mill.

That this development has been well worth while from a load-building standpoint, is evident from the fact that our last appliance survey in the fall of 1936 reported 1,943 of these units in operation, and it is expected by the close of the current year, these will closely approximate 3,000, with an estimated consumption of 1,800,000 kilowatt-hours per year.

Interviews with approximately 200 users of this equipment recently reported by our field staff, have revealed the following information:



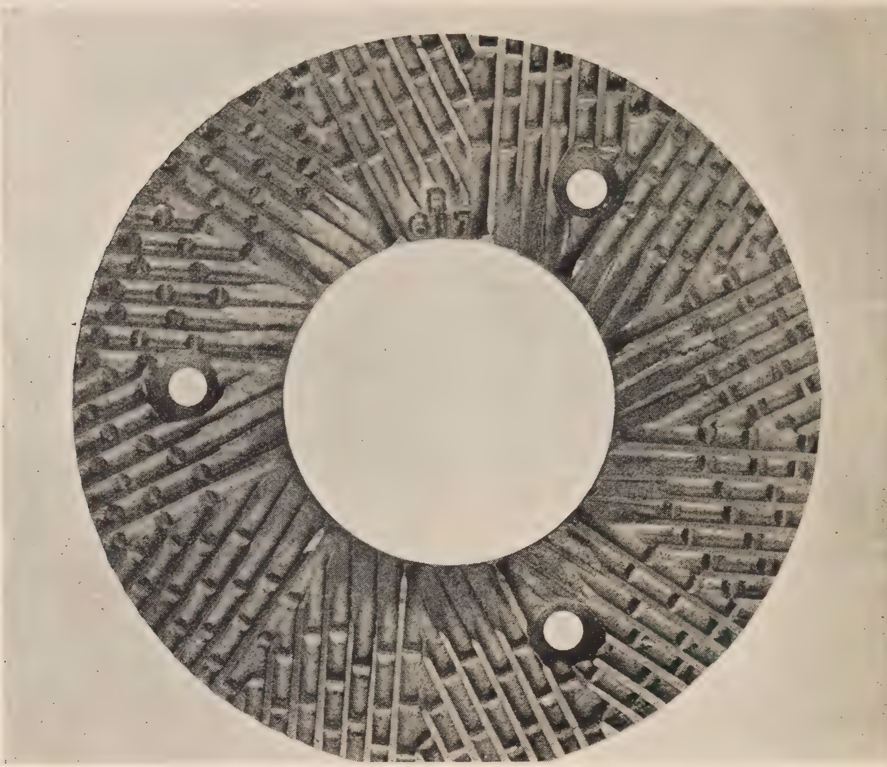
The Vert electric grinder made by W. Cockram and Company.

	Range—Bushels From	To	Average
Annual grinding requirements	400	6,000	1,650
Annual cash saving	$10	$150	$45
Annual saving in time	5 days	30 days	18 days

That these savings in cash outlay and labour are appreciated, is evident from numerous comments reported, many customers stating their savings are in excess of the annual cost of their entire rural electric service, and a large number are enthusiastic boosters of this equipment. The power take-off is extensively used.

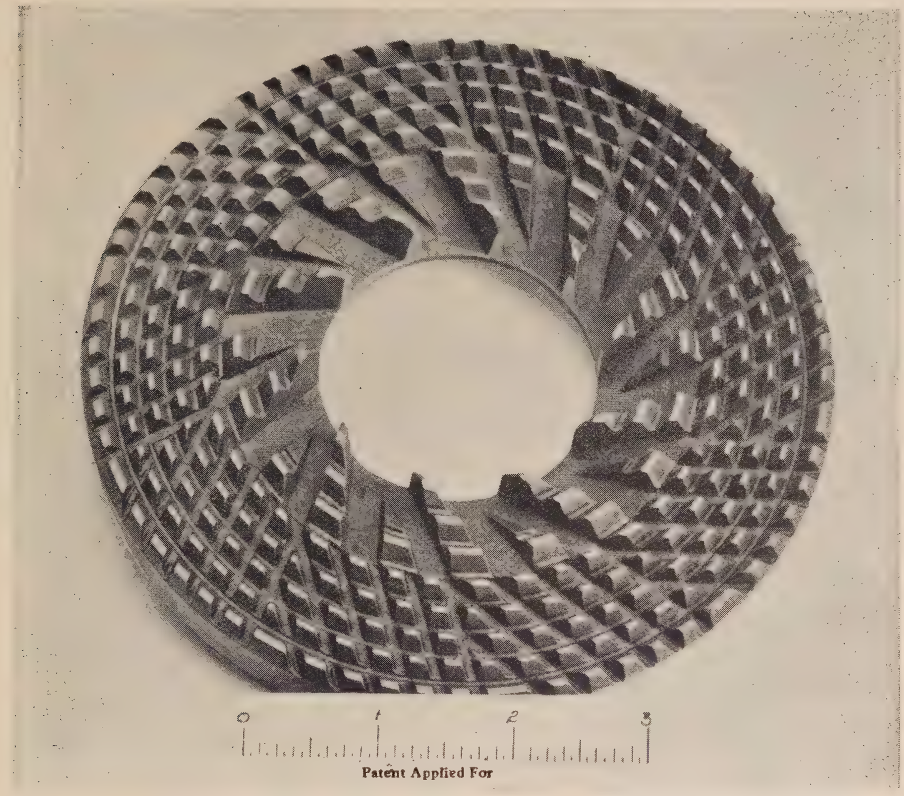
PLATE INVESTIGATIONS

In all the earlier tests, modulus of fineness was determined for each run. This indicated that practically all the plates tested, while they produced a satisfactory fineness when sharp, rapidly lost this characteristic. Small choppers, therefore, could not be expected to maintain a satisfactory fineness of product over an extended period unless the plates were sharpened or renewed frequently. In an



One form of attrition plate widely used on these small choppers.

endeavour to overcome this, the Commission undertook further research on chopper plates in the Commission's laboratory. In all, some 300 tests were made on various types of grinding plates available. Among the plates tested was a coffee mill plate which reduced material by a cutting or shear action rather than by a rubbing action, as in the ordinary attrition plate. While this particular plate proved unsatisfactory for grain, the results warranted further investigation of this shearing principle, as it offered a possible solution to the reduction of oat hulls which had proven most difficult, if not impossible. Several experimental plates were made, consisting of a series of raised teeth arranged in concentric rings, with radial grooves to distribute grain to the grinding area. Alterations in the arrangement of the grooves were made as tests indicated, in order to obtain a plate with an inherent feeding characteristic to match the grinding area. As this plate reduced material by a shearing action, it was necessary that the plate be operated with a minimum of clearance between the plates. This meant that the plate would produce one grade of chop, and could not be adjusted to wider clearances to produce a coarser product, as



The shearing plate developed by the Hydro Commission.

this was found to dull the cutting edges rapidly. As the teeth of one plate meshed with the grooves in the accompanying plate, accurate alignment of the stationary and revolving plates in the grinder head was necessary.

It was also evident that to obtain long life, some material with greater resistance to abrasion than cast iron was necessary. Many products were investigated for this purpose, until finally a nickel chromium cast iron alloy was used. Cast plates of excellent quality, which did not require subsequent heat treatment, were produced, the plates being finished as to cutting edge, by lapping them with an abrasive. Plates which have become dull in service can be sharpened by the same process.

Following tests in the laboratory, arrangements were made with a large stock farmer for an extensive run utilizing two of these small electric grain grinders, of different make. On this farm, large quantities of barley, wheat and corn were produced. The machines were equipped with the new plates and operated continuously, except Sundays, for approximately four weeks. The results were as follows:

	No. 1 Machine	No. 2 Machine
Hours of operation	342.75	324.5
Tons of grain chopped	50.06	46.25
Kilowatt-hour consumption	543	486
Average pounds output per hour	290.25	285
Average pounds output per kw-hr.	184	190

The fineness varied only slightly from start to finish. Examination of the plates at the end of the run showed wear on the inner sections, but very little wear in the outer sections. From the capacity at the end of the run and the quality of the product, it was believed these plates were by no means worn out, but could be expected to have a life approximating 100 tons and maintain their fineness and output.

These plates were designed to produce a medium grade of chop, which was believed would meet most requirements. It was appreciated that a plate of this type could be designed to produce a finer grade with reduced capacity, while a minor change in the existing plate would produce a coarse product with a substantial increase in capacity. The plate developed was made available and a number installed on these small grinders. Reports from the field, however, have been disappointing, the plates being used from three months to four years. From such information as has been available, it is evident that in many cases the fineness of the material produced by the plates did not meet the individual user's preference, and the plates were abandoned. In other cases, attempts were made to produce a coarser product by increasing the clearance between the plates, which resulted in rapid dulling of the cutting edges and reduction in the grinding capacity, which could possibly have been prevented by more definite instructions as to the proper adjustment of the plates. Also cost has been a factor in many instances, owing to the fact that the plates were made of a special alloy, and cost considerably more than the ordinary attrition plates. However, there have been a number of reports of very satisfactory operation of these plates. In one case recently reported, the plates have been used continuously for four years, and in that time have ground approximately 280 tons.

From the results obtained, we believe these plates have considerable merit and may warrant further experimental work along this line. However, a separate set of plates is required for fine, medium and coarse grinding, and this may not be acceptable to those farmers who require a wide range in the fineness of their grinding. As to the merits or demerits of feeding finely ground grain, there seems to be a very wide variation in opinion, and whether the benefits of feeding fine material are justified in view of the increased cost of producing such quality, by whatever method of grinding may be used, would seem to require further investigation.

(A paper presented before the Convention of the North Atlantic Section of the American Society of Agricultural Engineers at Toronto, October 12, 13 and 14, 1937.)

Series Lamp Operation

Notes from the Illumination Laboratory

IT seems evident from the attitude of many of the managers of Hydro systems toward street lighting that the number of lamps replaced per year is the only criterion by which the quality and cost of street lighting is judged. The importance of this item of cost is admitted. However, there are other factors that influence the total cost of street lighting that sometimes have a direct effect on the cost of replacements, particularly of series lamps. Sometimes attempts to economize lead to added expense, the cause of which is incorrectly assigned. For instance, sockets in faulty condition may and do cause the destruction of lamps; a substitute for the proper cut-out may cause the destruction of sockets when they are in good condition.

In every series circuit, two devices are necessary in each socket—a film cut-out in the head of the socket to enable current to flow when a lamp burns out and a short-circuiting spring to enable the current to flow when the socket does not contain a lamp. These are the causes of most of the unsatisfactory service.

Fig. 1 shows diagrammatically a series socket in a circuit. The cut-out at "A" contains an insulating material that insulates the opposite sides of the lamp circuit when the lamp is in normal operation, but which is punctured when the lamp filament is not continuous (burnt out or broken). It must withstand more than the lamp operating voltage without puncturing, but it must break down at a voltage that is not high enough to cause destructive burning of the socket. The short-circuiting spring at "B" may become soft on

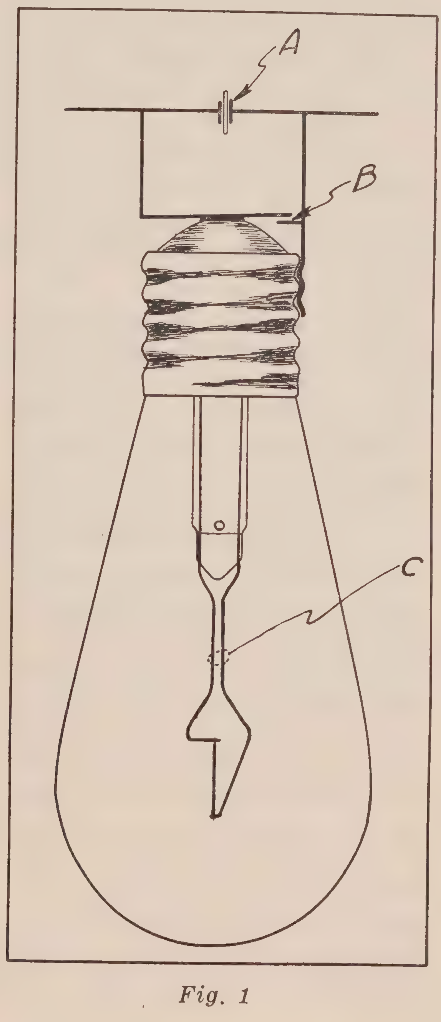


Fig. 1

account of the heat, and the metal finger with which it makes contact may get bent, so that the separation of the parts is much less than it should be. In the former case, the short-circuit contact when the socket is empty may be of very light pressure, causing high temperature which eventually leads to destructive burning and in the latter case, the gap may be so short that the no-load voltage at the moment of reclosing the circuit will cause an arc that will destroy the socket.

In spite of the cheapness of proper film cut-outs, many superintendents use substitutes and it is interesting to look into the economy of such a practice. Many a good lamp has been blamed for the burning out of a socket when the cause was a substitute for a proper cut-out.

An arc naturally follows a normal burn-out of the filament, but when the arc reaches the parallel sections of the filament supporting wires, the globule of molten metal caused by the arc bridges the gap between the wires and and the arc is stopped, as indicated at "C." When the parallel wires are properly formed and properly spaced, the chances of them failing to stop the arc are very remote. But, near the end of the lamp's life, the filament is very fragile and sometimes when the current is interrupted, the contraction during cooling will separate the filament into two sections and the vibration during the day may cause a piece of it to drop out of place. The next time the current is turned on, a proper cut-out will be punctured and no damage will be done to the socket, but a substitute may have such a high puncture voltage that the open-circuit voltage of the transformer may strike an arc between the leading-in wires close to the pinched seal of the stem which will be coated with tungsten deposited there by the filament and will, therefore, be of relatively low resistance. Such an arc will burn up the interior of the socket unless the cut-out punctures.

From time to time our attention has been drawn to materials that are substituted for film cut-outs and below are the puncture voltages of some of them, also the voltage across lamps of different sizes.

Puncture voltage of some substitutes for cut-outs:

Type of Paper	Thickness in Inches	Volts Dry
Cigarette	.001	440-500
Onion Skin	.001	390-520
Bond letter	.0035	1040-1200
Brown wrapping	.0028	690-720
Office scribbling	.0033	950-970
Newsprint	.0035	790-830
Magazine (Maclean's)	.0025	710-840

The nominal volts of 6.6 amp. series lamps are as follows:

600 lumens	7 volts
800 "	9 "
1000 "	10 "
1500 "	15 "
2500 "	24 "
4000 "	36 "
6000 "	54 "
10000 "	91 "

Puncture voltage of film cut-outs:

Low	50-90
Medium	100-200
High	200-350

It will be noticed that the lowest puncture voltage of the substitutes is nearly twice that of the highest film cut-out and about six times that of

the lowest cut-out, yet these substitutes are used to protect the small lamps. It has been complained that the cost of the cut-outs, 3c, is excessive, but a 3c cut-out will prevent the destruction of a $1.50 socket. At the rated life of Hydro series lamps, the cost of cut-outs will be considerably less than 5c per fixture per year. The series lamp life test rack in the Commission's laboratories has been in operation for over 18 years, only proper cut-outs are used and in that time not one socket has been burned out.

Corroded and scaled centre contacts in the sockets frequently cause local heating that burns the contacts on the lamp bases, resulting in the destruction of both lamp and socket. Owing to the vagaries of series circuits under the influence of climatic conditions, it is impossible to predict what might happen, but the use of proper film cut-outs is the cheapest, most effective means of preventing unnecessary destruction of sockets and a little attention to the condition of the contacts in the socket will save many a lamp that would otherwise come to an untimely end.—*G.G.C.*

An Indolent Family Put to Work

WE have some 90 odd elements in all, and chemists have known for a long time that these can be arranged more or less systematically in a periodic table containing eight groups or families. The members of each family resemble each other in chemical behavior but differ in physical properties—they are like a family of brothers of different heights, weights, and ages, who otherwise look alike, think alike, and act alike. Some of these families, like the chlorine family or the sodium family, react quickly and violently; they are continually looking for trouble, with chips perpetually on their shoulders. Others are a great deal more placid—silver and gold, for example, scarcely react at all. But the most phlegmatic, the most contended group by far is the family of the rare or inert gases.

This family of elements has several claims to distinction, for most of which its contented disposition is responsible. For example, no compounds of the rare gases exist in nature. They form the only group of elements in which every member is gaseous under ordinary conditions. The atoms of every other gas (like hydrogen or oxygen) will react with themselves to form molecules containing two atoms each; the rare gases are so inert that even their atoms will not unite, and their molecules consequently contain only one atom each.

With one exception, their names are derived from the Greek—and picturesque names they are: Helium, from the Greek word for sun, where

its spectrum was first discovered; argon means "no work", that is to say, lazy or content; neon is "the new one"; krypton, "the hidden one"; xenon, "the stranger"; and radon, meaning derived from radium, also called niton or "shining", because it forms a glowing solid.

In 1785, Henry Cavendish, one of the great chemists of all time, asked himself whether "phlogisticated air" as nitrogen was then called, might not be a mixture of many substances. He accordingly passed an electric spark through air and oxygen confined over an alkaline solution. Under these conditions, oxygen and nitrogen united to form nitrogen oxides, which the solution absorbed. The experiment was continued until further addition of oxygen and further sparking gave no more products that the solution would dissolve. Finally, another solution was added to absorb any excess oxygen; when this had been done, a tiny bubble of gas remained. Cavendish's conclusion, given in his own words, was: "if there is any part of the phlogisticated air of our atmosphere which differs from the rest and cannot be reduced to nitrous acid, we may safely conclude that it is not more than 1/120 part of the whole". The experiment was simple and convincing; it was carried out with such care that this result is now known to be only 15 per cent or so in error; and the conclusion was drawn in such masterly fashion that no essential change need be made in it to-day.

But Cavendish was far ahead of his time and his small bubble of inert gas appears to have been neglected for more than a hundred years. At the close of the last century, however, Lord Rayleigh encountered a puzzling discrepancy. He found that nitrogen prepared from air was slightly heavier than nitrogen obtained from chemicals. In a series of brilliant investigations, he proved that this difference was due to the presence in air of a new element heavier than nitrogen, which he named argon. In this way, a discrepancy that would have seemed trifling to many led to the discovery of a new family of elements and to the completion of the periodic table.

With argon discovered, further progress was rapid. Some years before Lord Rayleigh's work, an American, Dr. W. F. Hillebrand, found that certain uranium minerals when heated with sulphuric acid evolved a gas that he thought was nitrogen. Shortly after Lord Rayleigh's work, Ramsay and Crookes proved that this gas contained helium, whose spectrum had been observed in the sun's photosphere during an eclipse in 1868. In 1898, Ramsay and Travers fractionally distilled liquid argon (as crude oil is distilled to obtain gasoline, kerosene, and lubricating oil) and got three new elements, neon, krypton, and xenon. The family of the rare gases was completed about 1900 when it was discovered that radium spontaneously breaks down to give radon and a doubly charged helium atom, or alpha particle.

As the designation rare gases implies, these elements are not very abundant. Excepting only radon, however, they are all present in the

air we breathe. If from the air in a room of ordinary size the rare gases were extracted and confined in cubic boxes at atmospheric pressure, the box containing the argon would be fairly large, say, 26 in. on a side, for argon constitutes nearly one per cent of the atmosphere. The dimensions of the other boxes would be: neon, almost 3 in. for each side; helium, almost 2 in.; krypton, about 1 in.; xenon, about ½ in. In other words, the argon would fill a large refrigerator while the xenon would fill only a peanut shell.

There need be no fear of an immediate scarcity of these gases, however; each square mile of the earth's surface supports about 800,000,000 lb. of argon. The atmosphere at present supplies all the inert gases except helium and radon. Helium is extracted from the natural gas found in Kansas and Texas, the richest source of supply in the world—wells near Fort Worth give a product containing between one and two per cent of helium. These gases are so inert that their recovery must always be accomplished by physical methods—that is, by condensation and evaporation.

Since inertness is the outstanding chemical characteristic of the rare gases, this inertness suggests that these elements must have a unique structure, and so they do. In fact, this structure is extremely important in teaching us how atoms are built,—we might almost say that the rare gases would have to be invented if they did not already exist. All elements are built with the same building blocks; protons or positively charged units, electrons or negatively charged units, and neutrons, composed of a proton and an electron intimately joined and carrying no charge. The celebrated experiments of Lord Rutherford first taught us that the heavy particles, the protons and neutrons, are concentrated in a tiny nucleus, which is surrounded by the electrons distributed in shells, or (as the physicists prefer to call them) quantum levels. Lord Rutherford proved this structure by bombarding atoms with alpha particules, which are simply helium atoms with the electrons stripped away. Helium has only one electron shell, and this shell is filled when two electrons occupy it—there is room for no more. Each of the other rare gases has more than one electron shell; but no matter how many such shells there are, the outermost one always contains eight electrons, no more, or less.

Now, the electrons in the outermost shells make chemical reactions possible. If an element is built with a complete outer shell, to which electrons cannot be added and from which they cannot be taken away, then that element cannot react chemically. In other words, the rare gases are content with the number of electrons they possess and this contentment makes them chemically inert.

In connection with the use of helium for inflating dirigibles, freshmen students in chemistry are often perplexed by the fact that helium although twice as heavy as hydrogen has over 90 per cent the lifting power. This paradox is simply ex-

plained: The lifting power of a gas in air depends on the difference between its molecular weight and the average molecular weight of air, which is about 29. Thus 29 minus 2 gives 27 as a measure of the lifting power of hydrogen; 29 minus 4 gives 25 for helium. Helium, therefore has 25/27 times the lifting power of hydrogen, which is the lightest gas known.

Since helium has the lowest boiling point on record, only a few degrees above absolute zero, it is vital to all research conducted at very low temperatures. It is probable, also, that helium will assume considerable importance in deep caisson operations such as building the underwater foundations of our great bridges. The men engaged in these operations are subject to caisson disease, which is caused by atmospheric nitrogen at high pressure dissolving in the blood. When the pressure is released, the nitrogen forms bubbles in the capillaries, or the brain, or the spinal cord. The time required in coming out from under high pressure appears to be greatly reduced when a mixture of oxygen and helium is substituted for compressed air, because helium is less soluble in the blood stream than is nitrogen.

Neon is used chiefly in electric signs. Argon with some nitrogen added is used extensively in filling incandescent lamps. If the tungsten wire which is the source of light is operated in vacuum, the tungsten evaporates to the walls; the wire becomes progressively thinner until the lamp burns out while the walls become blacker so that less light passes through. An inert gas hinders evaporation and greatly increases the efficiency and the life of the lamp. The heavier the inert gas, the more effectively it hinders evaporation and the less it cools the lamp filament. With the older type of filament, a 40-watt krypton-filled lamp would be about 20 per cent more efficient than one filled with argon; with the newest type of filament, the gain would be considerably smaller. As long as krypton is so much more expensive than argon, its use is uneconomical for ordinary lighting even with the older filaments.

It is a long cry from Cavendish's small gas bubble to a helium-filled dirigible, a neon-lighted Great White Way, a modern incandescent lamp, or a spectacular attempt to approach more closely the absolute zero. And yet all these later things depend profoundly upon what mankind learned from that little bubble. One can almost hear the skeptics saying "Why work with these gases; They're so inert they're useless and so rare that you couldn't get them if they could be used." Certainly that was the common-sense point of view—but these apparently useless elements became important aids to civilization just the same.—*Excerpt from a G. E. Science Forum talk by Dr. H. A. Liebhafsky in "General Electric Review."*

Simcoe Schools Standardize on Indirect Lighting

By J. W. Bateman

During the past two years, Simcoe Public Utilities Commission has conducted a very thorough lighting campaign whereby practically the entire town was surveyed and the lighting in the homes of most of its customers considerably improved. A Home Lighting Advisor, specially trained by the Commission, carried on this work. Undoubtedly, the improvement in home lighting and the need for better lighting in the schools to protect children's eyes is responsible for the action taken by the Simcoe School Board in improving the lighting in the schools. Educational work carried on by the Hydro-Electric Power Commission is also a contributing factor.

WITH the widespread interest in improving school lighting conditions, the town of Simcoe, Ont., is to be commended on the example set in the complete lighting of its schools with modern indirect lighting. All the classrooms, a total of thirty, ten in the South Public School, ten in the North Public School and ten in the High School, now are indirectly lighted. The final twenty-two classrooms relighted in time for the Fall term have adopted the standard of six outlets per classroom, using three 500-watt lamps in the inside row and three 300-watt lamps in the outside row.

Now the 1,300 pupils, approximately 800 in the Public Schools and 500 in the High School, in this town of 5,500 population will have sight-saving illumination for their classroom work. Credit for the action which has been taken largely goes to the Simcoe Public Utilities for the educative work on lighting which they have done with the home and school clubs and with the school board, and to the school board for their special study and investigation of this classroom lighting problem which so materially affects the progress and welfare of the children.

Classroom Eyes

The new science of seeing has taught us much about our eyes, their functions and limitations, and the effect of the light by which we see. Through many centuries, our eyes have developed as outdoor eyes used to intermittent visual tasks, distance seeing and abundant illumination. Indoors in the classrooms young eyes are put to work under much different circumstances. This seeing task with text and exercise books and with blackboard work is of a relatively difficult nature. On bright days there is ample light on the outside rows of desks, but on the inside rows there is not enough light. A lightmeter test will show that where there may be from 75 to 100 foot-candles near the

Typical classroom at Simcoe, Ont., showing the glareless but adequate Sight-Saving indirect illumination.

The kindergarten classroom at Simcoe, Ont., also has indirect Sight-Saving illumination.

windows, the inside row of desks will have only five-foot candles or less. This amount of illumination is not enough for young eyes in the formative stages. Too low illumination will cause the children to squint and strain their eyes.

With classes on in the daytime some daylight can be counted upon during practically all school hours. On bright days, the children near the windows will have enough light, but on cloudy and dark days, they will need some artificial lighting to supplement daylight. It is for this reason that two lighting circuits are installed in the classroom, one for the three outside lighting units and one for the three inside units. Each circuit is switched separately. The inside row is equipped with 500-watt lamps and is intended to be operated all the time during classes. The outside row will be turned on only when daylight becomes inadequate.

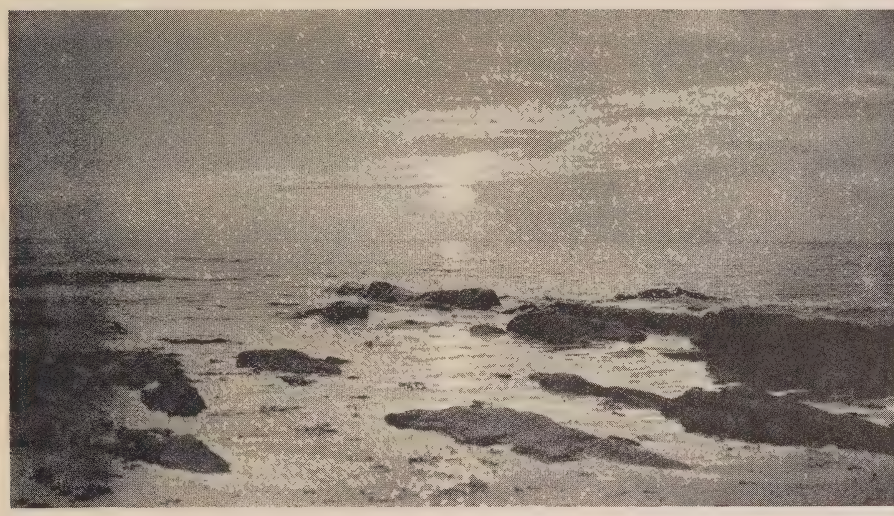
17 to 26 Foot-candles

The 132 lighting units installed just before school opening are Curtis No. 5050, 300-500 watt mirrored glass totally indirect units. The rooms varied in size with widths from 24 feet to 24 feet 8 inches and lengths from 30 feet to 33 feet 4 inches. The ceilings are white and the walls a neutral grey color. A survey of the lighting in various rooms made shortly after installation showed that this system without any daylight provides an average of 26 foot-candles on the inside row, 23 foot-candles along the middle row, and 17 foot-candles along the outside row of desks. The illumination on the front blackboard was approximately 17 foot-candles, and on the side board 20 foot-candles.

These values will naturally decrease about one-third due to lamp blackening and the collection of some dust and dirt. In order that the full benefits of an indirect lighting installation may be enjoyed, it is very essential that the lighting units be wiped out regularly. The lighting fixtures will collect dust in the same manner as the desks and, therefore, a proper maintenance schedule of cleaning about once every three weeks will be found worth while in order to obtain the most from the lighting paid for.

The Simcoe School Board has taken a very decided forward step in providing good lighting for the school children. Better light means brighter, more cheerful surroundings. This is invariably reflected in brighter, happier children. The advantage to those children who are actually backward or slow due to the inability to see well will be inestimable. Better lighting does make for more thorough assimilation of knowledge, better education and more efficient school operation. Numerous tests which have been conducted during the past several years indicate definitely that such is the case.

Good lighting is an aid to scholarship. It makes the classroom tasks easier. It helps supervision. Most of all, good lighting protects young eyes from the strain and possible permanent injury of improperly applied and insufficient lighting. It contributes to the happiness, progress, good health and welfare of the growing school children. — *Electrical News and Engineering.*



The Length of a Day

HOW long is a day? Opinions often differ. The artisan, keenly interested in his task, finds the day "all too short," whereas the anxious watcher beside a sick bed, awaiting the crisis, may think the day "seems like a week". The length of a day, however, cannot be just a matter of opinion; it is a period of time measured off by the sun, and is partly daylight and partly darkness at any chosen location.

In very early times, the days apparently began, and ended, at noon—"the evening and the morning were the fourth day". This arrangement must later have proven very inconvenient, necessitating the change so that the days would start, and end, at midnight. The *date* of the day now changes when midnight crosses the International Date Line—the 180th meridian, approximately.

The solar day is the length of time which elapses between any two successive transits of the sun across any given meridian, or of solar midnight across that meridian. The average of these periods, taken over one year, is commonly known as the "mean solar day", and, for convenience, is divided into twenty-four equal hours, with the subdivisions of minutes and seconds.

The solar day, then, is sometimes longer, and at other times shorter, than this average. The variations in length are about the same every year, and are as follows: (Table I.)

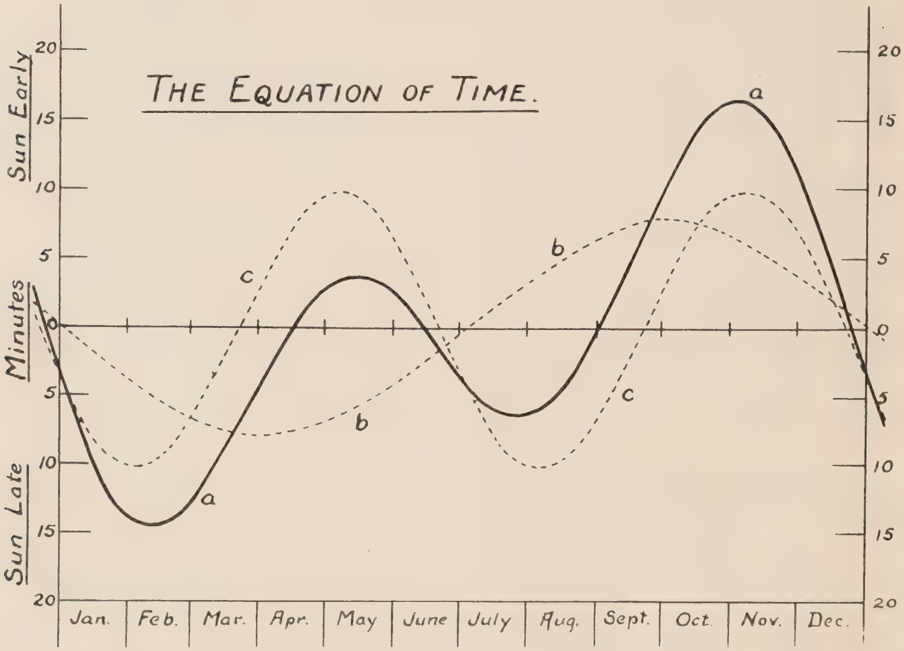
Due to these daily variations, the sun crosses the *standard meridians* as much as 16 minutes, 21.8 seconds, ahead of time, on November 3rd, and is 14 minutes, 24.7 seconds, late on February 12th. It is "on time" on these meridians on just four days in the year, namely, April 15th, June

TABLE I.

January	1st	days are		28 seconds too long
February	12th	"	"	of average length (24 hours)
March	21st	"	"	18 seconds too short
May	15th	"	"	of average length
June	23rd	"	"	13 seconds too long
July	28th	"	"	of average length
September	12th	"	"	21 seconds short
November	3rd	"	"	of average length
December	23rd	"	"	30 seconds too long

14th, September 1st and December 25th.

The curve showing by what amount the sun is early or late each day is known as "The Equation of Time", as illustrated. Latitude is not a factor in this equation. For any longitude, other than the standard time meridians, however, a time constant must be added to, or deducted from, the values given on this curve, according as the location considered is, respec-



The Equation of Time: The curve (a) showing by how many minutes the sun is early or late in crossing the standard time meridians.

This curve is the resultant of two components,—

(b) Variations due to the earth's orbit being an ellipse instead of a circle.

(c) Variations due to the earth's axis being inclined rather than at right angles to the plane of the orbit.

tively, east or west of its standard time meridian. The value of this constant is proportional to the difference in longitude between this given location and this meridian — i.e., four minutes per degree of difference.

Toronto is so far west of its standard time meridian — the 75th meridian, West of Greenwich — that the sun never arrives here on time. Even on November 3rd, when it is at its earliest, it is still about one minute late in crossing this local meridian.

These variations of the sun are so great that they would cause considerable inconvenience in many instances where measurement of time is required, so the "mean solar day" has been almost universally accepted, and the sun's variations practically disregarded except in astronomical calculations and in checking position at sea.

Now the earth makes a complete rotation on its axis every 23 hours, 56 minutes, 4.09 seconds — a period known as the "sidereal day", or day measured by the stars—but the mean solar day is the full 24 hours. The reason for the difference is found in the movement of the earth along its orbit—this planet revolves around the sun in one year, i.e., 360 degrees in 365.24 days, or nearly one degree per day. After the sun has crossed a meridian, the earth, therefore, must rotate on its axis, 360 degrees, and about one degree more, before the sun will cross the meridian on the following day. This extra "degree" requires nearly four minutes of earth rotation, which makes up the difference between the earth's period and the length of the mean solar day.

On other planets, and also on our moon, the days differ from ours, in length, namely:—

Earth— 24 hours.
Mars— 23 hours, 39 minutes, 20 ± seconds.
Jupiter— 9 hours, 55 minutes.
Saturn— 10 hours, 14 minutes, 24 seconds.
Uranus— 10 hours, 45 minutes,
Neptune—15 hours, 48 minutes.

$\left.\begin{array}{l}\text{Mercury}\\ \text{Venus}\\ \text{Pluto}\end{array}\right\}$ Periods of rotation not known.

Our Moon—29.53 days,—the average lunar month.

(The units used here are our standard hour and our mean solar day.)

The periods will, on the average, be half daylight and half darkness, for any given location on a planet's surface.

It is very reasonable that all of the larger planets,—Jupiter, Saturn, Uranus and Neptune,—rotate in about half the period of the smaller planets, —the earth and Mars.

The length of a solar day, then, is not a fixed period. It varies for the different planets, and according to the time of year for some of them. The conventional day,—the mean solar day on this earth,—therefore, has proven much more satisfactory "for everyday use."—*F.K.D.*

The Romance of the Calendar

ONE of W. A. Deacon's book reviews in *The Globe and Mail* gives the following brief digest of P. W. Wilson's book which bears the above title. It is possible that a new arrangement of the calendar may be adopted within a very few years, which makes Mr. Deacon's digest, tracing calendar development down through the ages, of more than passing interest.

The World Calendar Association is converting the League of Nations to regularization of the months and quarters, so that each quarter will have ninety-one days divided into one month of thirty-one days and two of thirty days. New Year's Day, between December and January, will have no number; and in leap years another day will be inserted between June and July. As it is nearly 200 years since England and the United States adopted the Gregorian or Catholic Calendar, P. W. Wilson's "Romance of the Calendar" is a timely reminder of the steps in the more than six thousand years of calendar reform.

The measurement of time, older by thousands of years than the ten commandments, and more generally observed, was man's first cultural thought. The Gregorian calendar, international, inter-religious, interracial, is becoming universal. It is "a miracle of unanimity in a discordant world." Derived from sun, moon and stars, the calendar far antedates the mechanics of modern astronomy. It is older than the remotest exact date we can fix—New Year's Day, 4241 B.C.

The day is a natural cycle—one rotation of the earth, from dawn to dawn or noon to noon. The year is a natural cycle—one circuit of the earth around the sun, approximately 365¼ days. The difficulty has been due to the fact that primitive man believed that the lunar month—29½ days—should fit evenly into the solar year, and there is no way to eliminate the fractions. The time of the moon circling the earth is not geared to the journey of the earth around the sun.

In the sixth century B.C., the Babylonians had measured the year within twenty-six minutes, but they clung to the lunar calendar. The Egyptians at a very early period adopted the sun and discarded the moon. They set the year at 365 days, divided into twelve months of thirty days with five holy days extra. This calendar dates from 4241 B.C. The Greeks foolishly clung to the moon, with resulting confusion; but the Romans learned from the Egyptians that there is only one time and that is sun-time, fitting in with the seasons.

Of course there were adjustments to be made on account of the extra quarter-day, which is actually 5 hours 48 minutes 46.2 seconds. The priests regulated the calendar. In Mexico, China, Europe, India, Babylon and elsewhere, the calendar was the "most widely useful of all conveniences that has been given to the community by religion." When Rome

took over the Egyptian calendar, the priests charged the people for telling them the date; and politicians, by bribing the priests, manipulated the calendar for politician purposes.

Julius Caesar took away the priestly monopoly of regulating time and fixing festivals. His calendar, with the same twelve months we know—ten named with the names we still use—was divided into alternate months of twenty-nine and thirty-one days, because even days were unlucky and this division gave more odd days in the year. Augustus, Julius' successor, regularized the quarter-day by instituting leap year in A.D. 8. Pope Gregory, in 1582, dropped eleven days by way of adjustment with the seasons and provided that, in future, leap year should be omitted in three out of four centennial years. This gives us a calendar that is only one day out in 3,323 years.

This Gregorian calendar has won the world. Queen Elizabeth refused to adopt it because of its Catholic origin; but in 1752 England had to fall in line. Russia did so in 1918, China in 1911, Greece in 1923 and the Orthodox or Greek Catholic Church in 1935. There are still some local irregularities. The fixing of Easter, for instance, caused a split in the Church, and this is still done by the moon cycle.

Mexico evolved one of the finest measures in the old Aztec calendar. But the adoption of the Roman or Gregorian or Catholic calendar enabled both Mexico and Great Britain to dispense with the human sacrifices that had been associated with the great seasonal festivals.

He has shown how casually people accept as immutable a calendar that is the evolution of thousands of years and is only now beginning to be the same everywhere. Islam, for example, maintained a special Mohammedan calendar until 1917, when Turkey ordained the use of the Gregorian. Canada was hoping to switch to the new arrangement of regular months in 1939, but negotiations between States will probably take longer. It is safe to say, however, that millions now living will live to see thirty days in February and also in March. Doubtless opposition will arise from printers who now have to print a new calendar for every year. In the new arrangement, the first days of January, April, July and October will always be Sunday and the year will always end on Saturday night, Dec. 30, while Christmas will forever be a Monday.

Soil Heating

By N. E. Macpherson, B.A.Sc., Assistant Engineer, Municipal Engineering Dept., Hydro-Electric Power Commission of Ontario

THE Commission's engineers for some years past, have been interested in the subject of electric soil heating, realizing that if economically feasible, it provided considerable opportunity for load building. As the result of several small experimental installations made through the co-operation of manufacturers in 1930 and 1931, a program of investigation of the feasibility of this application was undertaken by a committee appointed for the purpose.

The greater part of the committee's work has been in co-operation with interested growers and manufacturers. A number of trial installations of electric hotbeds and cold frames were made, and a wide range of plant material dealt with under commercial growing conditions, including the germination of tomato, cabbage, cauliflower, eggplant, pepper and flower seeds, as well as the sprouting of sweet potatoes, which were particularly successful, several times the usual number of plants per bushel of seed being reported. This work was done in greenhouse benches and hotbeds, and included the first set out of all the above material. In cold frames, tomatoes, cabbages and sweet potatoes were protected against frost.

The results have been very satisfactory, with a few exceptions where the use of the equipment was not fully understood. Among the causes of failure, all of which are avoidable, are the following:

Poorly fitted sash, causing excessive air infiltration.

Failure to water frequently enough, largely due to the fear of causing dampening off of the plants. This, however, has been noticeably absent in hotbeds. The soil in hotbeds must be kept reasonably moist to facilitate the transfer of heat from cables to the air.

Improper thermostat settings, largely due to the fact that the early thermostats had no scale by which their setting could be even approximately determined.

During this early work, bottom insulation was generally considered necessary. However, this involved considerable labour in converting existing beds, and several installations were made without it. Our observations have lead to the conclusion that bottom insulation is not, in many cases, required. A sheltered location, with good under-drainage, well banked sides and well fitted sash, have proven more effective in reducing energy consumption.

Accurate data on the annual cost of manure beds have been difficult to obtain. Such data as have been available, however, give in general a comparison favourable to the electric hotbeds, particularly where manure is obtained from a distance. Even though the savings in some cases may be small, the ease with which any desirable minimum temperature can be chosen and automatically maintained,

permitting acceleration or checking of growth, as conditions may warrant, together with the superior results obtained, makes electric hotbeds and cold frames feasible.

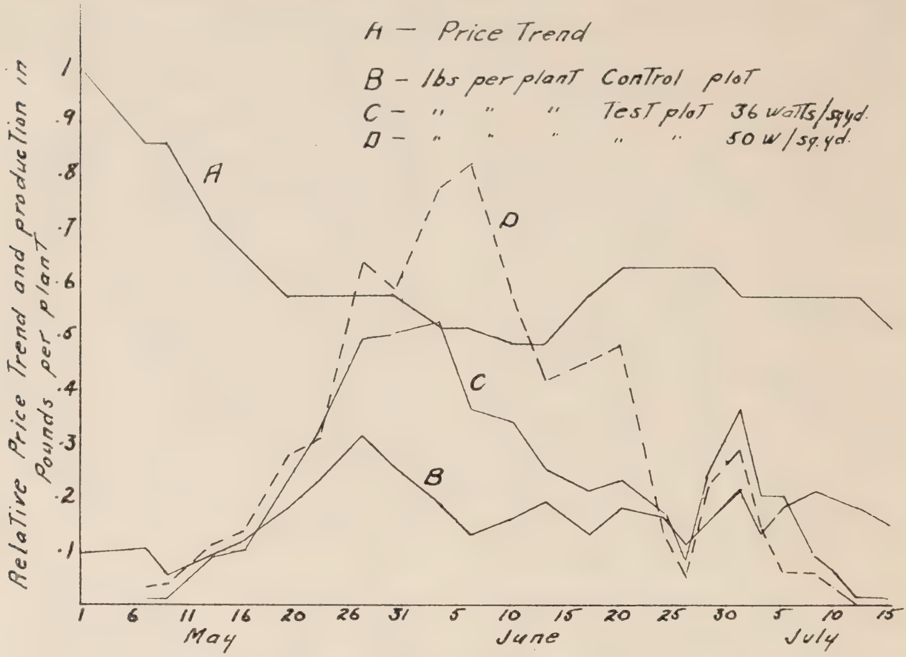
Interest developed in the possible application of soil heat in growing tomatoes and cucumber crops in green houses. An interested commercial grower made available a house comprising 102 square yards. In 1935, one half this house was equipped with 50 watts per square yard of soil heating cable, and the other with 36 watts per square yard. Each section was controlled by two thermostats set to maintain a temperature of 75 degrees, three inches below the soil surface for the first ten days, and thereafter were set for a temperature of 65 to 68 degrees. Cables were installed nine inches deep. An adjoining house was used as a control. In both cases, a minimum air temperature of 50 degrees was maintained.

Tomatoes were set in this house on January 23, 1935, and the growth in the soil heated area was rapid. On April 18th, the plants were an average of six feet, with the seventh fruit truss on the majority of the plants in the 50-watt per square yard section. In the check house, the average height was 36 inches, with the fifth truss just appearing. It was noted that in the heated area, there were more multiple trusses above the fourth than had been previously experienced, and the fruit set better. The following tabulation and curve give a summary of the results of the complete crop:

	Lbs. per Plant	%
Production per plant:		
Check house	4.1	100
Test house, 50 watts per square yard	6.44	157
36 watts per square yard	5.15	125
Relative gross revenue per plant:		
Check house		100
Test house, 50 watts per square yard		154
36 watts per square yard		119.3
Relative net revenue after deducting cost of energy and depreciation of equipment on 5-year basis:		
Check house		100
Test house, 50 watts per square yard		116.5
36 watts per square yard		95

It should be noted that the above net revenue does not take into consideration any allowance for saving in fuel, due to maintaining a minimum temperature of 10 to 15 degrees below that usually recommended for this crop. The lower production from the 36 watt per square yard area is undoubtedly due to the lower average soil temperature which this heat flux was able to maintain.

Soil heating was also used for the late fall crop ending in December. The same thermostat settings were used, but did not operate until October, when the fruit had already set. No appreciable increase in the crop was obtained. This would indicate that soil heat is not required during the later stages of plant development, and a saving in energy consumption and cost in the 1935 experiments, therefore, may have been possible had soil heating been discontinued at an earlier date.



Tomato production with and without soil heating.

In 1936 and 1937, tomatoes were again grown in the 36-watt per square yard area, but owing to the introduction of other factors, the results may not be directly comparable with 1935. However, 1936 showed a considerable reduction in the advantage of soil heating, while 1937 showed a radical reduction, the production of the heated plants being only 86 per cent. of that in the control house. The early spring of 1937 was unusually cloudy and dull, particularly the month of April, and was later followed by a prolonged spell of very favourable growing weather. It would appear that the plants in the control house, being possibly at an earlier stage in their growth, were able to take advantage of this and maintained their production for two weeks longer than the soil-heated plants. A somewhat similar result has been observed with tobacco plants.

In these particular experiments, soil heating did not materially advance the date of the first picking. It did, as a rule, increase, some times substantially, the production during the early productive period when higher prices usually prevail. Consistent increases in total production were not obtained owing, in part, to the fact that the plants in the control house usually maintained their production for from a few days to two weeks longer than the soil heated plants. It is evident that the extent of the early increase in production due to soil heating, and the total production, are to a large extent controlled by other conditions, the amount of sunlight no doubt being a factor. While the re-

sults of these particular experiments can not be taken as conclusive, they are interesting and valuable in revealing practical problems and conditions which must be met by the grower. The results of work along similar lines undertaken in England, which have recently come to our attention, have indicated that the use of soil heating does not justify a reduction in the air temperature maintained in the greenhouse, and further they indicate a rather wide variation in the effect of soil heating on the total production.

In order to evaluate the effect of the various factors affecting plant growth, it is necessary to have experiments under much closer observation and control by trained horticulturalists. Realizing this fact, and being fully aware of the possibilities of the use of electricity in horticulture, the Commission has recently undertaken jointly with the Ontario Agricultural College, a program of experimental work in connection with the use of electric soil heat and the application of light to plant growth.

(A paper presented before the Convention of the North Atlantic Section of the American Society of Agricultural Engineers at Toronto, October 12, 13 and 14, 1937.)

Association of Municipal Electrical Utilities

Nominations for 1938

The scrutineers' report on the primary ballot of the Association of Municipal Electrical Utilities shows the following nominations for the various offices for the year 1938. These names are listed in the order of the nominating votes received by each. Where a person may be nominated for more than one office the by-laws of the Association rule that the office showing the greater number of nominating votes shall be given precedence. These nominations are subject to the wishes of the nominees, but the names marked with an asterisk (*) are those which according to the scrutineers' report would appear on the election ballot, provided there are no withdrawals.

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VICE-PRESIDENT:

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SECRETARY:

S. R. A. Clement*; S. Buckrell*; and J. R. McLinden.

TREASURER:

B. Faichney*; S. E. Preston*; W. B. Munro; R. M. Bond; S. Buckrell; F. A. Archer; E. B. Easson; and W. H. Ferguson.

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Eastern District:

S. W. Canniff*; R. J. Smith*; A. L. Farquharson; M. W. Rogers.

Northern District:

C. J. Moors*.

The election will be at the winter convention of the Association on February 8th and 9th, 1938. Ballots will be distributed during the first morning of the convention, namely—February 8th and up to the opening of the session on the afternoon of that day. The results of the election will be announced before that session closes.

O.M.E.A. and A.M.E.U. Convention

At Royal York Hotel, Toronto

February 8 and 9, 1938

THE BULLETIN

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Captain S. B. Iler, M.C.

IT is with deep regret that we record the sudden passing of a popular member of the Hydro staff in the person of Captain Stanley Burritt Iler, M.C., on Friday, December 10th, 1937.

Up to Saturday, December 4th, he attended to his duties at the office as usual and had arranged to bowl with one of the teams in the Hydro Commission Bowling League on the following Monday evening. On the morn-

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Vol. XXIV No. 12

DECEMBER, 1937

The purpose of the Bulletin is to furnish information regarding the Hydro-Electric Power Commission; to provide a medium for the discussion of "Hydro" matters and to maintain the co-operative spirit between municipalities, as well as between municipalities and the Commission. Articles of interest are invited for publication.

ing of that day he was taken with a sudden critical illness and rushed to the hospital, but medical skill was without avail.

"Stan" was born in Quebec city in 1888, but while he was only six weeks old his parents came to Hamilton, Ontario. Later they moved to Toronto and after that to Belleville. Here he attended the public and high schools and on matriculation entered the School of Practical Science in Toronto, where he graduated in 1908. During 1909 and 1910 he was employed with the Canadian General Electric Company at Peterborough, after which he went to the firm of Smith, Kerry and Chase, Toronto. In 1912 he joined the staff of the Brantford Hydro-Electric System where he stayed to the end of 1913. The year 1914 he spent with an engineering firm in Edmonton, Alberta. In 1915 he joined the Canadian Expeditionary Force with the rank of Lieutenant, from which he was later promoted to that of Captain in the Signal Service of the Canadian Engineers. While still a Lieutenant he was awarded the Military Cross for distinguished service in maintaining communications during the battle of Vimy Ridge. On his return from the war in 1919 he came to the Hydro-Electric Power Commission of Ontario, entering the Municipal Engineering Department, where he has served continuously as a District Engineer in the Eastern Ontario District. The knowledge he gained and the associations he made while with Smith, Kerry and Chase, who supervised the Electric Power Company before it was taken over by the Commission particularly fitted him for this work.

Captain Iler's happy, quiet, conscientious disposition and likeable nature won for him many friends both in the Hydro office and in the municipalities under his supervision. Everywhere he was held in the highest esteem.

Captain Iler is survived by his widow and two young children, a son and a daughter; also two brothers, a sister, and his step-mother. To all of these we extend our sympathy in their bereavement.

Engineers' Banquet to Dr. T. H. Hogg

AS a tribute to Thomas H. Hogg, B.A.Sc., C.E., D.Eng., the new Chairman of The Hydro-Electric Power Commission of Ontario, upwards of 800 engineers and friends of Dr. Hogg met at a banquet in his honour at the Royal York Hotel, Toronto, on the evening of December 8th. The banquet was arranged by a committee representing the following societies: The Engineering Alumni Association of the University of Toronto; The Engineering Society, University of Toronto; The Engineering Institute of Canada; The Canadian Institute of Mining and Metallurgy; The American Society of Mechanical Engineers (Ontario Section); The American Institute of Electrical Engineers (Toronto Section); The Engineers' Club of Toronto; The Canadian Institute of Chemistry and The Association of Professional Engineers of the Province of Ontario. Among the invited guests who attended were the Honourable Albert Matthews, Lieutenant-Governor of the Province of Ontario, some of the Cabinet Ministers in the Ontario Government, the Hydro Commissioners, the President of the Ontario Municipal Electric Association and the President of the Association of Municipal Electrical Utilities.

The General Chairman of the dinner, A. Ross Robertson, President of the Engineering Alumni Association of the University of Toronto, referred to letters received from engineers and engineering societies in all parts of Canada expressing regrets on account of being unable to attend, and good wishes for Dr. Hogg in his work. These included letters from C. A. Magrath and T. Stewart Lyon, former Chairmen of the Hydro Commission. The toasts and replies all voiced the general approval of the Government of Ontario in appointing an engineer to the Chairmanship of the Commission and choosing one who has worked many years as one of the Hydro staff and is thereby familiar with the work.

The toast to the Province of Ontario was proposed by Balmer Neilley, B.A.Sc., M.E., Past President of the Canadian Institute of Mining and Metallurgy. The Honourable Gordon D. Conant, Attorney-General of the Province of Ontario, replied to this toast on behalf of the Prime Minister, The Honourable Mitchell F. Hepburn, who was unable to attend. He pictured Ontario as the premier province in Canada as to population, industry, natural resources and the use of electricity and placed the Hydro-Electric Power Commission as third or fourth corporation in the country as to finances, the Dominion and the Province of Ontario being first and second, while the Hydro Commission and the Province of Quebec are about equal.

W. C. Kettlewell, President of the Ontario Division of the Canadian Manufacturers' Association, proposed the toast to the engineering profession. This toast was replied to by

Angus D. Campbell, B.A.Sc., M.E., President of the Association of Professional Engineers of the Province of Ontario.

The toast, "Dr. Hogg and The Hydro-Electric Power Commission" was proposed by J. B. Carswell, B.Sc. Eng. (Glasgow). As a manufacturer, using large blocks of Hydro power, he was very high in his praise for the service he receives. Dr. Hogg's reply to this toast is reproduced hereunder.

Dr. Hogg's Address at the Engineers' Banquet

TO-NIGHT I address myself to the engineering fraternity of Canada partly because the nine societies which have sponsored this gathering in my honour are thoroughly representative of the engineering fraternity of Canada, partly because individual references to each society might call for distinctions of some delicacy, and partly because, on this unique occasion, my heart goes out to the profession at large.

In an interview given last month, I made a statement to the effect that I was not interested particularly in my job as Chairman but was intensely interested in what could be done with it. This was one way of intimating that there is attached to this post a responsibility so great, involving a burden so considerable as to more than offset any personal satisfaction or feeling of pride arising out of the distinction which it carries, leaving only one thing to rejoice over; fortunately that one thing is a very big thing in which I said I was *intensely* interested, "*what can be done with the job*". I am inspired by the opportunity to do something much greater than I have ever done before for one of the greatest institutions in my native province in whose service I am proud to say I have spent the best part of my life; for that opportunity I wish to express my most sincere thanks to the Prime Minister of Ontario and his colleagues. To you who have so spontaneously expressed your approval of my appointment, I feel the deepest personal gratitude. At the same time I feel that the choice of an engineer as Chairman of the Commission is a tribute to the engineering profession to which I belong, rather than a mark of personal distinction. May I quote part of a paragraph from one of the most gracefully phrased letters of congratulation which I have had the good fortune to receive:

> "It must be particularly gratifying to you after your years of public service, to know that through your appointment the stamp of approval has . . . . been placed on the Engineering branches of the Hydro . . . . I know I join a host of your admirers in wishing you a long tenure of office, so we may rest content in the

knowledge that the Hydro is in safe hands."

I cannot tell you how much happiness, courage and inspiration I have received from letters such as this. How can any man fail to do his very best when he is supported by the knowledge that so many friends pin upon him their hopes for the accomplishment of fine things, confident that he will not be found wanting?

Opportunities have opened up to me through my activities as an engineer, and my reputation as an engineer is dear to my heart. The activities which are described as "executive", and which will henceforth claim an even greater portion of my time than formerly, are of a more recent order.

Years of experience in the engineering field inevitably establishes as a matter of course, cautious approach, careful inquiry and measured appraisal, the attitude of mind which can rest only on a firm foundation of fact, and which frowns on irresponsible exaggeration and subterfuge; I think you will agree that this common heritage of the mature engineer is an asset in any responsible post. However, for responsible executive positions, something more is required; there must be the capacity to effectively synchronize, each in its proper perspective, a variety of administrative functions and to so direct the co-ordinated organism that its purpose may be fully, effectively and economically achieved. I can only hope that the qualities and capacities demanded for the performance of the executive duties which now devolve upon me may prove to be present in sufficient measure to enable me to discharge the trust which has been placed in my hands in a manner which will reflect credit upon the Commission, so that it will continue to be a source of pride to its employees and the public at large.

Early Struggles and Risk of Transformation

The story of the origin and phenomenal development of that great institution founded by Sir Adam Beck which we, in Ontario, call "Hydro", must be familiar to most people in this province and to many elsewhere, for it has been told over and over again. Yet I sometimes wonder how many grasp the significance of the story or have more than a meagre appreciation of the nature and function of this enterprise which is so vital to the well-being of Ontario homes and industry; indeed many of those who have been immersed in "Hydro" activities for upwards of twenty-five years or more must pause and take stock to realize what it is to-day, so great has been its growth and extension, yet so unobtrusive.

There is no occasion, to-night, to indulge in agreeable and congratulatory reflections about triumphs of the past, for our minds are on the momentous present which, as always, must be viewed in relation to both the past and the future. We turn to the known past for that setting or perspective which, if we can but read the facts aright, enables us to comprehend the significance of the present and predict the trend of the future, for we must shape our course in relation to that trend. Any brief excursions into the past will be made in quest of signifi-

cant perspective material rather than for material that will emphasize the transformation which has taken place.

Prior to the depression, the whole enterprise was characterized by an uninterrupted record of expansion, until it seemed as though there could be no end to it, not even a pause. This period was not without difficulties. Difficulties in obtaining power to meet the rapidly increasing demands. Difficulties due to selfish interests, and many other difficulties too numerous to mention. It is inevitable in a great public undertaking of this kind, subject as it is to the inter-play of so many forces of ever varying nature and incidence that difficulties have always been and always will be with us.

This enterprise with its $314,000,000 in physical assets exclusive of any assets of the municipal electric utilities, its interest bill of $13,000,000 per year, its annual wage outlay between $8,000,000 and $9,000,000, its 41 generating stations aggregating 1,425,000 horsepower in capacity, its peak load demand which last year was about 1,600,000 horsepower, and this year will be materially greater, and its 18,000 circuit miles of transmission lines of all voltages, including rural, has tremendous potentialities for good. With proper handling, it is a servant of incalculable value, but lacking intelligent direction it may be transformed into an exacting taskmaster, perhaps even a gigantic octopus. If the interests of this institution should ever become secondary to other interests in the minds of the men who are at its head, then, surely the transition from servant to octopus is inevitable.

THREE PRINCIPAL FIELDS OF ACTIVITY

The object and justification for the existence of the Hydro-Electric Power Commission of Ontario is the distribution of power throughout the province in the best interests of all the people. Naturally, the people's interests demand that power be supplied at the lowest possible cost consistent with security of service and proper guarantees of future supplies. The Commission has no assets in its own right; it is simply a trustee administering the affairs entrusted to it. In the discharge of its responsibilities the Commission is active in three principal fields:—

1. The municipal field.
2. The field of rural supply.
3. The Northern Ontario field.

Bear with me while I enlarge somewhat on this even though much of the ground is familiar.

1. The Municipal Field

In the municipal field the Commission is principally concerned with the wholesale delivery of power to cities, towns and villages which, in turn, distribute it to individual customers subject to certain Commission supervision. The municipalities associate themselves into co-operative groups, usually referred to as systems, which collectively are responsible for all provisions made on their behalf in the form of power developments, transmission facilities, power purchases or services.

Each system is a separate and distinct entity, and the municipalities of which it is composed are entitled to all benefits derivable therefrom and obligated for all its losses, quite independently of the success or failure

of any other "system" or group of municipalities.

It is, of course, a cardinal principle that each municipality must pay its proper share of the cost of power and each municipality is obligated under the Power Commission Act and its contracts to ensure the Commission against default.

2. The Rural Field

In the second field, namely, the field of rural supply, the Commission is both wholesaler and retailer. The settled parts of the province are divided into rural districts. Each rural district derives its power supply from one of the municipal systems and pays for it on a cost basis as though it were a municipality of the group, and each is financially independent of all the others. Neglecting the fact that the Province bonuses rural areas to the extent of supplying half the capital cost of rural primary lines, rural power is sold to rural customers on a strictly cost basis at rates depending upon the district cost of power and the added cost of distribution; the Act provides for the collection of overdue accounts by tax levies.

It will be noted that in both the municipal and rural fields, the Province assumes no risk unless through the insolvency of its municipalities, for the latter are obligated under the terms of their contracts and the Power Commission Act for all expenditures made on their behalf by their trustee, the Commission.

In these two fields of endeavour, viz., Municipal and Rural, the Commission's physical properties have rapidly spread all over Southern Ontario, where there are now scores of generating stations, hundreds of transformer stations, and a veritable network of transmission and distribution lines.

3. The Northern Ontario Field

In Northern Ontario, the third field, the situation is quite different from either of the other two, and should be particularly interesting to mining men. In the main, even the settled part of the country is sparsely settled and a great deal of it is in the natural state. The distances are great and the principal demand for power comes from mines or industries associated with the mining industry. No group of municipalities exists in this territory which could possibly finance developments of the magnitude needed to supply the mines and allied industries. Consequently, the title to the power developments and transmission systems rests in the Province and the risk of loss, in case of customer default or from any other cause, rests upon the Province and not upon any group of municipalities as in Southern Ontario. The Commission operates the Northern Ontario properties, which consist of the Nipissing, Sudbury, Abitibi, Patricia, and St. Joseph districts, as trustee for the government.

Throughout these districts there is great activity. Generating stations, transformer stations and transmission lines are making their appearance at an astonishing rate. The large Abitibi Canyon plant is rapidly being loaded with primary power, generating stations have been established and extended on the Albany and English rivers at Rat Rapids and Ear Falls

respectively, and the recently acquired Crystal Falls plant on the Sturgeon river has been connected to the Wahnapitae system to provide for the growing load.

What should be the policy of the Commission, as trustee of the Government, in administering these properties? Clearly the answer is that enterprises belonging to the Province should be administered in the interest of the Province with due regard for local interests in the districts in which they operate; the importance of Northern Ontario's mining industry to this province must be given proper consideration in any decision as to policy.

Starting insignificantly in the 1890's, the metal mining industry of Ontario has now become one of the major industries of the province, second only to agriculture. Its output in 1936 was valued at $165,000,000, and the estimate of the Ontario Department of Mines for 1937 approaches $205,000,000. During 1936 it employed 23,000 men and paid an annual wage bill of $35,300,000.

Moreover, despite the ups and downs of the stock market, present indications point to a large and prolonged increase in mining activity. Forecasts of the Ontario Department of Mines indicate that there will be a 15 percent increase in mineral production in 1937 over 1936. Diamond drilling, which is always considered an excellent yardstick in appraising the general trend in mining development, showed a 100 percent increase in core footage in 1936 over 1935. Diamond-drilling companies alone spent last year $1,500,000 in wages and employed 1,473 men.

Since 65 percent of the rock of which Ontario is composed is favourable to the occurrence of minerals, it will be apparent, that even with the present rate of expansion, the peak of Ontario's mineral production is still far distant.

The direct and indirect benefits of the mining industry to Ontario are enormous. Its employees must be fed, clothed and housed, and all their needs must be provided, equipment and materials must be furnished, and large blocks of electrical power must be supplied.

Owing to the practically unlimited demand for its product, even when world trade was at its lowest ebb, the gold mining industry experienced no slack period. This support to Ontario industry was particularly helpful during the lean depression years.

Mines must have power, and many mines must have cheap power, otherwise they cannot operate. In many cases the Commission is in a position to supply the power at rates which permit the opening and operation of the mines, but the question of financial guarantees sometimes presents an obstacle. Will the mine prove itself, or will it be a failure? Caution urges against the investment of capital in transmission lines to supply a mine which may only operate a few years, and all manner of reasons are brought forward as to why the Commission, as Trustee of the Government, should take no risk but should invariably require the mines to deposit security which would guarantee the Commission against any possible loss.

Is this a short-sighted viewpoint? It is apparent that large capital expenditures should not be made on behalf of uncertain mining prospects, but may there not be circumstances under which the Province, through the agency of this Commission, might well co-operate with established mines in the construction of transmission lines which enable them to be supplied with electric power? Participation to this extent might be justified and might actually be made attractive by charging such rates for power, as, in the aggregate, would show a profit notwithstanding an appropriate allowance for short life and consequent losses. This is the practice of privately-owned power companies and the arguments in favour of its adoption by the Province are worthy of very careful consideration; for example, suppose a mine should close down after a few years of operation, leaving the Commission with a capital investment in a transmission line which has not been fully retired; is it not possible that the indirect benefit to the province of that few years of mine operation might more than offset the loss of the unretired capital so that the province would actually gain by a transaction which superficially might appear to be to its disadvantage?

A precedent already exists in rural operation for provincial aid where the indirect return justifies it. In that case, the Government furnishes capital to the extent of one-half the cost of the primary lines without any expectation of its return, whereas in the mining field it would look for compensation for all losses from revenue received from the successful mines. As already stated, this is the policy of large private power companies operating in mining areas. These companies recognize that they too must have a stake in the mines if the mining country is to be developed, and they are content to take more or less selected risks.

Since the Government already owns extensive power properties in mining areas and is subject to any risk which may appertain thereto, the taking of a small additional risk incidental to the co-operative construction of lines into established mining properties might even reduce rather than increase the overall hazard. While the mines must carry a proper share of the risk, may there not be sound reasons for the intelligent employment of government funds and government enterprise in Northern Ontario in co-operation with the mining industry to the mutual advantage of both having regard to the collateral benefits which are bound to accrue to the people of the Province of Ontario as a whole from any impetus thereby given to one of Ontario's major industries?

FINANCIAL RESERVES

In any large organization the question of financial reserves is one of great importance and considerable complexity. From its inception, the Commission has set up three principal reserves:—

1. A Sinking Fund, which is accumulated to retire all capital indebtedness.

2. A Depreciation and Obsolescence Reserve, which accumulates at a rate sufficient to make available for replacement or re-construction, at the

end of their useful life, the full capital cost of all buildings and apparatus.

3. A Contingency Reserve, which is drawn upon to defray the cost of all manner of individually unpredictable events, for example, damage caused by lightning, winds, and floods. This contingency reserve furnishes the broad stabilizing influence of insurance.

As the state of these reserve accounts is an indication of the soundness of the general financial position of Hydro, it has been the subject of considerable public discussion of late years. I do not intend to analyse these reserves or the security which they provide, but I am very pleased to say that they are in excellent condition and that Hydro's position is very strong indeed. The safeguarding of these funds and the continuance of a sound policy with respect to reserves is quite evidently one of the most important duties of the Commission, and I assure you that I shall let nothing interfere with their maintenance in the soundest possible condition, while at the same time making such proper use of them as they were and are intended to fulfil.

Sketch of Load Trends

After the intense anxiety of depression and early recovery years, it is pleasant, and I think I may say, without being misconstrued, that it is gratifying to contemplate the healthy, vigorous and substantial load growth which all systems of the Commission are showing. Leaving out of consideration all deliveries of secondary power, namely surplus power which the Commission supplies at will or when available, the Niagara System has been running 10.5 percent higher than last year, Eastern Ontario 11 percent, Thunder Bay 18 percent, and Georgian Bay, where the Ragged Rapids plant of 10,000 horsepower is under construction, none too soon to provide for next year's growth, 8 percent above last year. In the northern districts, Abitibi is up 41 percent, Sudbury 8 percent, Nipissing 10 percent, Patricia 18 percent, and St. Joseph 77 percent. Last December the annual growth in primary load of all systems was 9.6 percent, and there is every indication that that figure will be exceeded this year.

Notwithstanding the importance of this question of load growth, a detailed analysis of the figures is altogether too intricate for presentation here; publication of further information relative to loads will be reserved for future statements.

Power Reserves

Prior to the fall of 1925, there had been a great deal of discussion as to the advisability of making extensive steam power developments which was terminated by a pronouncement of the Commission in favour of hydraulic power. I wish to point out that there are still extensive undeveloped hydraulic power resources in Southern Ontario on interprovincial or international streams, where the development of power cannot be undertaken without interprovincial or international agreements. As agreements of this kind often take considerable time to consummate, the prospect of obtaining power from these sources, in the immediate future, is uncertain. However, every possible effort should be made to develop and utilize these re-

sources before resorting to steam, although, for certain special purposes, steam power may have its place in the composite framework of the Commission's resources and in the not too distant future.

As an engineer, I am acutely conscious of the fallibility of even the best apparatus, of the reality of the service threat to existing plants through the enormous forces of floods, winds, and ice, and of the degree of probability that substantial losses in supply may occur, for considerable periods of time and for a variety of reasons. This is not a question of timidity; it is simply a realization of the nature and ominous consequences of the possible occurrence of certain events, commonly classed as contingencies, which might disastrously affect the service being rendered by the Commission.

Can the industries of this province complacently face the possibility of a shortage of power? You, as engineers, recognize the enormity of the consequences of a serious shortage for weeks or months, but do the people at large, who would be called upon to face that loss, realize what it would mean? I think not.

Considering the hazards and the weight of responsibility which rests on this Commission, and bearing in mind the lengths to which other large public utilities go to provide against contingencies, I ask you whether it is surprising that I stress the necessity of making provision for the two undernoted requirements:

1. Provision of a continuously available power reserve, in excess of primary requirements, to meet contingencies which may arise without warning.

2. Positive provision for future load growth so as to guarantee adequate supplies from economical sources.

This question of future supplies is one on which I wish to make my meaning very clear, so, at the risk of labouring the point, I shall cite an example:

Suppose a survey of resources indicates that from the long-range viewpoint, it is economical and desirable to undertake a certain large hydraulic development, and suppose that three years must be allowed from the time this project is authorized until power can be obtained from it. It is obvious that such a development must be authorized at least three years in advance of the anticipated date on which power from it will be needed and that the estimated growth requirements of the intervening years must either be in hand or available on demand or otherwise obtainable and assured. When I speak of the availability of supplies for future growth being assured, I have in mind leaving as little as possible to chance, being prepared with normal plans and alternative plans so that, while advance commitments will be reduced to a minimum, there will be no appreciable likelihood of any power shortage at any time.

It is only the part of common prudence to avoid onerous commitments so long as the future is not being jeopardized by doing so, but it is also the part of wisdom to complete preliminary arrangements and always have work so well in hand as to be

able to meet, by acceleration of existing programs or otherwise, whatever growth in demand is reasonably probable; failure to do this may have much more serious consequences than an error in the reverse direction, especially as the cost of reserve power is comparatively little owing to the ready market for it on an at-will basis.

THE STAFF

There is a question that has recently excited a great deal of public interest and, in some quarters, considerable apprehension, about which a few words may be appropriate here; I refer to the nature of the relationship between employer and employee, often referred to as the relationship between capital and labour. The struggles which have taken place in the past between employer and employee indicate very clearly that it is not wise to have employees who are dissatisfied, much less resentful and bitter. Such a state of affairs is demoralizing and adversely affects the efficiency of the service being performed. When no better alternative is in evidence a worker will usually accept with comparative cheerfulness a very low wage provided he is convinced the business in which he is employed cannot properly pay more; whereas he would keenly resent being held down to a low rate if he were convinced that a higher rate were in all fairness amply justified.

The full significance of this will be apparent when it is remembered that no system of supervision or coercion will wring from an unwilling disgruntled worker his best efforts, for his best is invariably the spontaneous product of his interest, his enthusiastic voluntary effort and his "will to do," as well as his skill and intelligence. Compared with this "best" the grudging minimum of the dissatisfied worker is but a poor apology, expensive at almost any price.

I believe this to be a fundamental psychological fact and the prime reason why progressive management today recognizes the need for scrupulous fairness in dealing with employees and lays such stress upon the establishment of effective channels through which views and ideas may be interchanged, facts displayed, explanations made, agreements reached and mutual understanding attained, to say nothing of much incidental technical benefit. Without such a channel suspicion is apt to grow into misunderstanding, misunderstanding into resentment and resentment into cessation of work.

Workers usually respond to progressive managerial methods of this kind and quickly recognize the mutuality of their interest with that of management. Their attitude of mind towards management changes from one of suspicion and latent antagonism with all its attendant dangers of possible injury to the business in which they are engaged, to one of sympathy and understanding which in turn stimulates in them the otherwise dormant desire to increase their efforts in the interests of that business in the confident hope and expectation that their efforts will be fairly rewarded by management; in other words, the spirit of understanding and fairness displayed by management begets a like spirit among the workers.

In the Commission's case this contact channel has been established for

the benefit of all employees, through a plan of representation, by which employees are provided with duly accredited representatives who act on district and general committees, and meet with management representatives. While the plan is young as yet, much has already been accomplished in the way of establishing improved standards of wages and working conditions, and it is my firm conviction, that properly administered, in a spirit of frankness, fairness, mutual appreciation of difficulties and sympathetic readiness to make concessions, it will be of the greatest value, both to the staff and to the Commission. I am sure you will agree that it is only proper, both from the viewpoint of economy and social justice, that a large publicly-owned utility such as ours, should give constructive leadership in the matter of fair treatment of its employees, especially when it is realized, that taken by and large, the individuals who comprise the Commission's staff are well trained and well qualified for their work. If the foregoing is accepted it must also be conceded that special care must be exercised in the selection of employees for the service according to qualifications, that systematic training methods are necessary, and that those who fail to measure up to the progress requirements must be weeded out at the earliest possible stage, in their own interest as well as that of Hydro.

In short, the performance of the Commission's staff is a matter of great importance, and nothing should be left undone to establish and maintain it upon the highest possible level.

The splendid reputation now enjoyed by all ranks of the Commission's staff has been earned by loyal and efficient service and is well deserved. I have for them only words of the highest praise and I am confident that the Commission can count on them all to maintain if not improve their present record in this respect.

THE RIGHT TO KNOW AND CRITICIZE

Under the British system it is considered that every citizen of voting age has an inalienable right to have a voice in government and in public affairs relating thereto. The method of expression may vary widely but the right remains.

This principle has some significance to Hydro when one stops to consider that the assets held in the name of this Commission, of which I have the honour to be Chairman, belong to the people of this province. It must be evident that the people whose assets are being administered by the Commission, under well-defined powers, have very definite rights which their trustee, the Hydro-Electric Power Commission of Ontario, deriving its authority from the Legislature of Ontario, must recognize. I refer to the right to *know* and the right to *criticize.*

Without public confidence the administration of a publicly-owned institution must become more or less weak and lacking in constructive contribution. Therefore, the Commission must maintain and, if possible, increase public confidence in its administration; failure to do so would be fatal. But how *can* public confidence be acquired and retained without keeping the public fully and effectively

informed about all important Hydro matters and encouraging constructive criticism of Hydro affairs?

Let me voice a word of caution about public criticism. Criticism may be just or unjust, intelligent or ignorant, well-meaning or selfish, straightforward or misleading, constructive or destructive, but, if it is not actually vicious it all has its place; in the main, public criticism, like vigorous opposition in government, is healthy, particularly if it is honest. It promotes caution, a tendency to weigh and consider. It reveals new viewpoints and new vistas which might otherwise escape attention. In the case of this Commission even the somewhat irritating and troublesome investigations of the past have brought in their train indirect benefits.

Nevertheless there is a time and a place for everything, and even though I am not altogether a newcomer to this work, a short period of adjustment will necessarily be required to enable me to properly and intelligently appraise my responsibilities; when the adjustment period is over I shall welcome constructive criticism.

My Colleagues

My remarks to-night would not be complete if I did not refer to my fellow-commissioners. From the very first, both Mr. Houck and Mr. Smith have given every indication of their firm intention to discharge their duties in formulating and directing Hydro policies in a way which will do credit to themselves, to the Commission, and to the municipalities. Notwithstanding the fact that they have many other important duties to perform, I am sure Hydro affairs will claim first place in their interests and efforts and that they will derive much satisfaction from the knowledge that they have played their part in maintaining the integrity and traditions of this great publicly-owned utility.

Conclusion

There is one thing that I hope I need not say to those who know me well, but which I would like to say to those who do not. It is that I approach my new responsibilities as Chairman of the Hydro-Electric Power Commission with humbleness of mind. My duties as Chief Engineer will not take me away from familiar ground, but those of Chairman involve a greatly extended field of activities and call for the exercise of very different qualities.

No aspect of my future work is more attractive to me or, I think, to my fellow-commissioners, than the prospect of conferring with municipal commissioners and others, gathering information concerning their difficulties, making explanations as to the possible courses open to the Commission, and endeavouring to reach a satisfactory solution of our mutual problems.

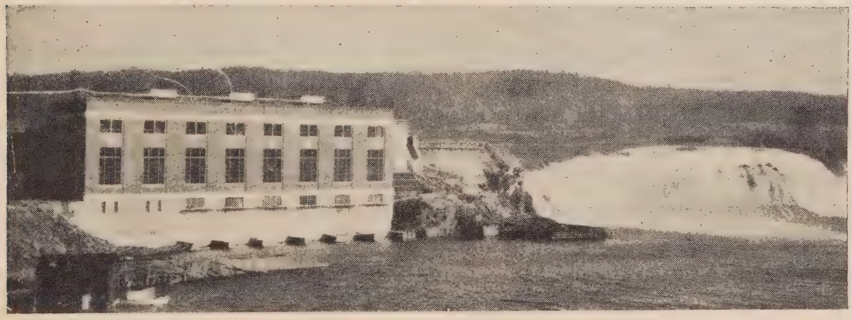
Before closing, there is one last word I would leave with you; it is not new, yet it can scarcely be driven home too often. Its import should appeal to all, quite independently of personal attitudes toward the principle of public ownership, for, faced with the actuality of this publicly-owned institution which is obviously so vital to the domestic and industrial well-being of Ontario and so inextricably interwoven into the very

core of it, even those who strongly prefer private to public ownership must concede that the die is cast and that we must stand or fall by our publicly-owned enterprise.

If we do not want excellence in the conduct of Hydro affairs to lapse and become one of the many sporadic things which momentarily appear upon the stage of life only to disappear and be forgotten, we must constantly be alive to the dangers which from time to time beset Hydro and we must test all proposals with respect to it in the light of their effect upon the future. It is all too easy to be lost in contemplation of the magnitude of modern undertakings, particularly of physical creations, and all too usual to fail to appraise their human significance from the viewpoint of whether or not they will endure or continue to fulfil the purpose for which they were created or for that matter whether they will continue to serve any useful purpose at all.

If this viewpoint is to *be carried forward as time goes on* the Commission must constantly seek to improve the already high standard of Hydro service, to maintain it at a level which will be unexcelled elsewhere and to expand the great advantages which Hydro affords the people of Ontario so that the public will become increasingly Hydro-conscious and will have a more complete realization that Hydro is a vital force upon which the industrial life and domestic comfort of Ontario largely depend. Moreover, those good citizens who recognize the importance of this must take an active part and help to establish and foster a spirit of public pride, not only in preserving this splendid heritage but in encouraging its development along lines most adapted to the needs of the future, until this spirit becomes a tradition. If we think of ourselves as trustees, who, though not exactly answerable to future generations for our acts, are, nevertheless, morally responsible for handing down this great public heritage unimpaired, we shall probably not go far astray.

To you, my friends, who by your efforts and attendance have made this wonderful gathering possible, I again wish to say that I am deeply grateful.



Alexander power development with spillway discharge.

Street Lighting Requirements

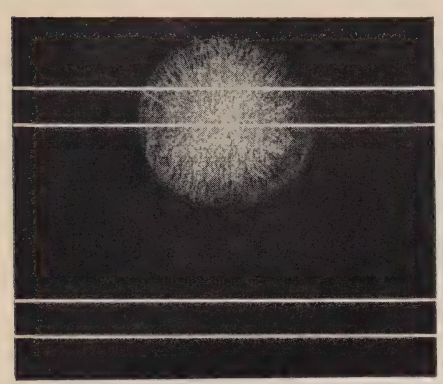
By George G. Cousins, Illumination Laboratory,
H.E.P.C. of Ontario

THE security of the citizens should be, and usually is, the chief concern of all municipal governing bodies. Protection from injury to those who use the streets at night is a matter of major importance. The distribution and intensity of illumination for the various districts is influenced by factors such as ornamentation for residential districts, illumination of the buildings in shopping districts, but it should not be overlooked that safety is the prime requisite of all street lighting and safety depends upon the ability to see. It follows, therefore, that all considerations of street lighting should have visibility as the starting point. Pedestrians must be able to see obstructions in their paths as well as prowlers and suspicious-looking characters. Drivers of motor vehicles must be able to see immediate surroundings to detect, with certainty, other cars, pedestrians, objects on or holes in the road and the many things that may cause accidents.

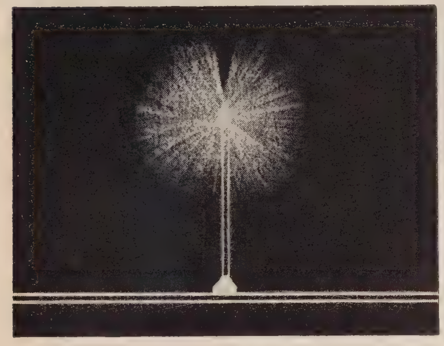
The source of greatest danger on the streets is motor-driven traffic and because of this any factor that enables drivers to see farther or more quickly will save human lives and limbs. It is obvious that there must be light on the road but an inspection of the characteristics of much of the lighting equipment that is used will show that a very small percentage of the light produced by lamps reaches the roadway. One lumen on the road is worth many lumens any place else.

The article, "Saving Lives with Light," by L. J. Schrenk, an abstract of which appears in the October issue of the Hydro Bulletin, presents an outstanding example of the results of taking lumens from the surroundings and placing them on the roadway. In one section described the effectiveness of the lighting was greatly increased without any increase in watts by replacing diffusing glassware with light-controlling equipment.

Street lighting luminaires are of two general types, diffusing and light-directing. The diffusing luminaires scatter the light in all directions with the result that only a small percentage reaches the road. They include opal and rippled or pebbled crystal glass. The light-directing or light-controlling equipment includes silvered glass, prismatic glass and polished metal either separately or in combination. Porcelain enamel has some reflecting properties but it is not capable of effective control of light and is usually not classed as light-controlling equipment with respect to street lighting. Light-directing luminaires not only reclaim a large percentage of the upward light from the lamp filament but also redirect it from the surroundings onto the road where it is needed. There are some light-directing units that have rippled glass as an outer envelope and some prismatic glasses that



Horizontal light distribution.



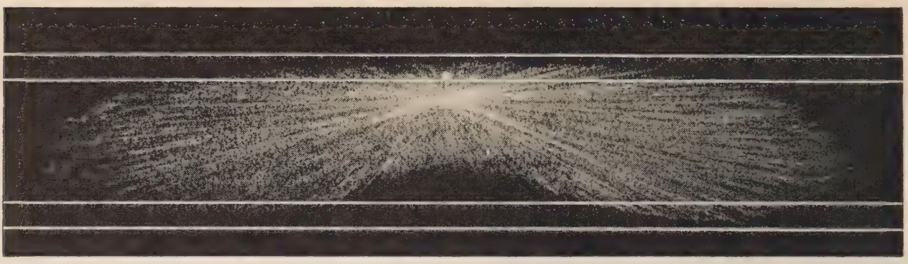
Vertical light distribution
Fig. 1

are rippled on the exterior surface. These should not be mistaken for diffusing units.

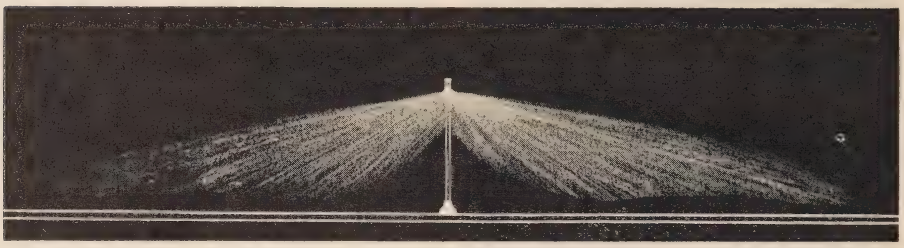
The bare lamps radiate about half of the light upward and half downward. They are obviously extremely inefficient. The diffusing luminaires do not appreciably change the distribution of light from the lamp but only absorb a considerable percentage of it and soften its light. Even though some reflectors such as porcelain enamelled ones reflect a considerable portion of the light downward there is still but a very small percentage of it that reaches the road.

Figs. 1 and 2 illustrate the difference between diffusing and light-controlling equipment. The diagrams show the relative distribution of light from the same size of lamp in the two types of luminaires. They also show the difference between ineffective and effective use which is referred to later.

Discernment of objects on a road is mostly by means of the silhouette effect, by which objects are seen as dark against bright light reflected from the pavement and in order to see objects in such a way there must be a light source beyond the object and in line with it, approximately. Effective use of light requires the light to be distributed in such a way and to be mounted in such a position that its light will be reflected from the pavement toward the drivers of vehicles. It is evident that the luminaires must be over the pavement to produce the best silhouette effects and consequently the greatest visibility. Furthermore, it requires high intensity of light at angles that would strike the road midway between luminaires. Comparing the two luminaires shown, the one in Fig. 1 is a diffusing type mounted over the curb in which position it is very ineffective while Fig. 2 shows a light-directing type in a more effective position over the pavement. In Fig. 1 it is readily seen that the distribution of light will not produce satisfactory reflection of light from the pavement for good visibility, while Fig. 2 shows light distributed in such a way that the pavement, as seen by approaching drivers will appear bright. The effectiveness of Fig. 1 will be slightly increased by



Horizontal light distribution.



Vertical light distribution.
Fig. 2

mounting the luminaire over the pavement but at best it is a very inefficient and glaring unit. Figs. 3 and 4 illustrate actual results produced by such luminaires.

The desirability of utilizing as large

Fig. 3—Ineffective Lighting.

Diffusing luminaires.
Low mounting height.
Luminaires over the grass instead of the roadway.
Lack of pavement brightness.
Low visibility.

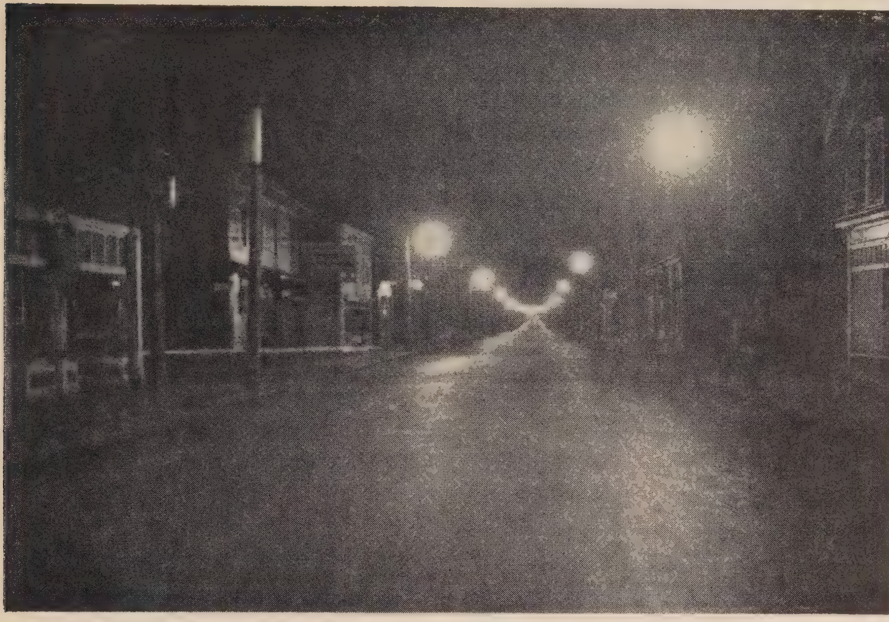


Fig. 4—Effective Lighting.

Light directing luminaires.
High mounting height.
Luminaires suspended over pavement.
Good reflection of light from pavement.
High visibility.

a percentage of light on the roadway as possible is apparent, but it need not be feared that by so doing that sidewalks, lawns and the immediate surroundings will be left in darkness. It is economically impracticable to make equipment to control the light so accurately that such would be the case. Nevertheless there are residential streets with the houses quite a distance from the curbs that call for some study of the relative importance of the illumination of grounds in front of houses and the roadway and the means of satisfactorily illuminating both.

On business streets the buildings themselves should be illuminated. Here there is a different combination of conditions. There is usually more traffic but it moves at much slower speeds. High intensity of illumination is necessary for advertising value and this, in turn, contributes to safety. Visibility here is not so dependent upon the brightness of the pavement as upon the brightness of the objects or persons themselves. Each type and classification of street has its particular requirements and one type of luminaire will not be the most suitable for all.

The Street and Highway Lighting Committee of the Illuminating Engineering Society has for many years been studying the requirements of the various classes of streets and highways and its recommendations represent the accumulated knowledge and experience of a body of men who are vitally interested in the subject. Following are quotations from the Committee's report as included in the Transactions of the Society, January, 1935:

Recommended Practice

"The following recommendations for street lighting should be understood to be minimum recommendations. It is the opinion of the Committee on Street Lighting that it is clearly desirable to provide more than these minimum recommendations wherever feasible."

"This specification is based upon the use of equipment of the most effective type in the most effective manner. With less effective equipment or less effective application of light, larger lamps or closer spacings are required. The minimum mounting height of 18 feet should be employed only where trees are present or other conditions making a higher mounting height impracticable. Mounting heights between 20 and 25 feet are recommended where practicable."

Qualifying Provisions

"It should be specially noted that where luminaires are indicated to be placed on brackets extending out beyond the curb, the light is being used in an effective manner; when placed back of the curb, the effectiveness is reduced. The latter placement will usually call for the next larger size of lamp or for closer spacing than mentioned in the specifications."

Classification of Streets

"Light traffic thoroughfares usually carry a maximum of not more than 500 vehicles per hour in both directions.

"Medium traffic thoroughfares usually carry a maximum of approximately 800 to 1,200 vehicles per hour in both directions.

"Heavy traffic thoroughfares usually carry a maximum of more than 1,500 vehicles per hour in both directions."

Light Traffic Thoroughfares

"For light traffic thoroughfares the minimum recommended is a staggered arrangement of lighting units with luminaires located on brackets extending out beyond the curb at a mounting height of not less than 18 feet; with this mounting height the spacing should not be greater than 150 feet; with such mounting height and spacing the lamp rating should not be less than 4,000 lumens. On narrow thoroughfares (as 25 feet between curbs) lighting units may be located on one side of the street although better results will be obtained if the units are staggered."

Medium Traffic Thoroughfares

"For medium traffic thoroughfares the minimum recommended is a staggered arrangement of lighting units with luminaires located on brackets extending out beyond the curb at a mounting height of not less than 18 feet; with this mounting height the spacing should not be greater than 150 feet; with this mounting height

and spacing the lamp rating should not be less than 10,000 lumens."

Heavy Traffic Thoroughfares

"For heavy traffic thoroughfares the minimum recommended is an opposite arrangement, or equivalent, of lighting units with luminaires located on brackets extending out beyond the curb at a mounting height of not less than 18 feet, even where trees are present; with this mounting height the spacing should not be greater than 150 feet on each side of the street; with such mounting height and spacing the lamp rating should not be less than 10,000 lumens."

Business Districts

"Business streets should be classified as to vehicular traffic in a manner similar to that adopted for thoroughfares and the same minimum standards of illumination should apply for each class, due consideration being given to other local conditions. Retail business streets should never be lighted to a lower standard than that for medium traffic thoroughfares. Where there is considerable pedestrian traffic these minimum values should be increased. If the luminaires are not placed over the roadway, lamp sizes should be increased."

	Not less than
For lamps of 25,000 lumens and over minimum height	24 feet
For lamps of 15,000 lumens	20 feet
For lamps of 10,000 lumens and less (See footnote)	*18 feet

*Where one-storey buildings predominate, a minimum mounting height of 16 feet is sometimes justified.

Residence Streets

"For residence - non - thoroughfare streets the minimum recommended is an 18-foot mounting height for luminaires located on brackets extending beyond the curb, even where trees are present; with this mounting height the spacing should not be greater than 150 feet, although conditions may sometimes necessitate spacings as great as 200 feet; with such mounting height and spacing the lamp rating should not be less than 2,500 lumens. At closer spacings a lower mounting height, not less than 15 feet, is permissible. Also 1,000-lumen lamps may be used at the minimum mounting height of 15 feet and closer spacings, preferably not exceeding 125 feet.

"At intersections of residence streets carrying only local traffic, not less than one 4,000-lumen or two 2,500-lumen lamps should be installed."

Characteristics of Luminaires

"There are no conditions of street lighting prevailing in the United States which justify the use of smaller than 1,000-lumen lamps. The 2,500-lumen lamp is the smallest size which may be used with good economy."

Lamp Placement Transverse of the Street

"It is quite generally agreed upon among engineers that a lamp of a given candlepower, placed well out over the pavement, is equivalent in roadway illumination to a lamp of considerably greater candlepower located inside the curb line."

This code is a very comprehensive, but brief, presentation of the funda-

mentals of street lighting and those interested in the subject should have a copy for detailed study.

There is a fairly general opinion that any lighting, no matter how low, is better than none. The truth of this is seriously open to question as it is well known that glare nullifies the effectiveness of illumination, to varying degrees depending upon conditions and a small exposed lamp may cause sufficient glare to nullify the low intensity of illumination that it produces. For other applications of electrical power, equipment is selected that is suited to each particular need. Why not do the same with street lighting equipment? If lighting for a street that carries motor-driven traffic is under consideration, prevention of traffic accidents is the most important consideration. Therefore the type of lighting equipment that will provide the greatest safety for the money spent is the only type that may be justifiably installed. The guidance of someone familiar with the requirements should be sought and followed.

The subject of street lighting is much too broad to be covered by a short article. The foregoing is an attempt to emphasize the importance of effective utilization, principally. This aspect of the subject does not seem to have received the attention that it should have. With the most modern equipment, most effectively used, it is possible to utilize about 40 percent of the light from the lamp on the road. With ordinary non-directing equipment mounted back of the curb the percentage of light utilized on the road is but a small fraction of the above value. The difference in cost between efficient, effective lighting and inefficient, ineffective lighting represents money paid for human lives and the elimination of suffering.

NOTE: Copies of the Street Lighting Code may be obtained for 10c each from the Illuminating Engineering Society, 51 Madison Ave., New York.

Adjusting the Years

SPEAKING literally, we measure our lives by years, and we depend upon the seasons for our food supply. It therefore becomes important that the length of the year be accurately measured, and it also is very desirable that such arrangement be made that the seasons will remain in adjustment.

There are three different lengths of year measured off by the movements of the earth,—the sidereal year, the anomalistic year and the tropical year, the latter sometimes called the solar or equinoctial year.

While it is customary to define a year as the period of time required for the earth to make one revolution on its orbit around the sun, this definition applies with exactness only to the sidereal year. The other years are, respectively, longer and shorter than this period.

The Sidereal Year

The length of time which elapses from the instant that the earth is in direct line between the sun and any particular star or its meridian until our planet returns to the same position,—a movement of exactly 360 degrees around the sun,—is the year as measured in reference to the stars and, therefore, is known as the "sidereal" year. Its length, at present, is 365.2564 days or, in more detail,—
365 days, 6 hours, 9 minutes, 9.5 seconds.

The period is increasing but extremely slowly,—about at the rate of 0.0001 seconds per year.

This year is used chiefly in astronomical calculations.

The Anomalistic Year

The earth travels on an elliptical orbit, slightly eccentric, and therefore varies its distance from the sun by a small amount during the year. At its nearest approach to the sun, the earth is said to be in "perihelion." This now occurs about January 2nd.

Not only does the earth revolve around the sun, however, but its orbit, in effect, is slowly revolving eastward so that the point of perihelion moves, running away from the earth at the rate of 11″ (of arc), or 1/330 degree, per year. The period required by the earth to pass from one perihelion position around the orbit and to reach its perihelion again, is known as the "anomalistic" year, slightly longer than the sidereal year. Its length is 365.2596 days, or—
365 days, 6 hours, 13 minutes, 53 seconds.

This year also is slowly increasing. It is not of importance, however, as it is not much used for reference.

The Tropical Year

While the earth is rotating on its axis, that axis is slowly changing its direction, moving, as it were, around the surface of a cone which has its apex at the centre of the earth. In other words, the earth's axis is wobbling, westward, as a spinning top, but requiring 25,800 years for one complete cycle of the wobble,—slightly more than 50″, or 1/72 degree, per

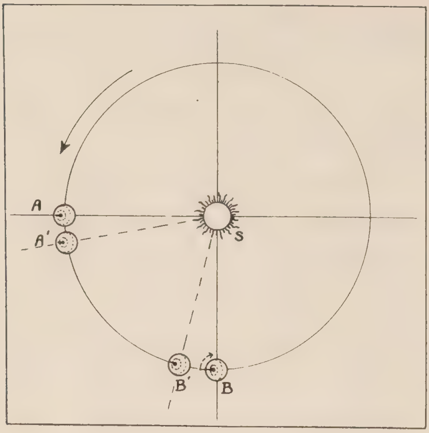


Fig. 1.—The Three kinds of year,—The sidereal year,—the earth moves from A around the sun and back to A again. The anomalistic year,—the earth moves from A around the sun to A and then on to A′, the new position of the perihelion. The tropical year,—the earth moves from B, the vernal equinox, around the sun to B′, the new position of the equinox nearly a year later.

year. This phenomenon was discovered by Hipparchus about 125 B.C.

This wobbling movement causes what is commonly known as "the precession of the equinoxes,"—the gradual moving forward, in the sidereal year, of the two instants when the sun crosses the equator, and when days and nights are of equal length,—the vernal (spring) and autumnal equinoxes. The forward movement of the equinoxes, and also of the seasons, amounts to 20 minutes, 24 seconds per year,—i.e. one day in 70.6 years, or one month in 2,150 years.

The period from one vernal equinox until the next is known as the "tropical" year,—the year of the seasons. Its length, at present, is 365.2422 solar days, or,—
365 days, 5 hours, 48 minutes, 46 seconds.

This year is very slowly decreasing.

As it is more important that the seasons be kept in fixed positions in the year than that the stars be in the same apparent positions in the heavens on any given day, the tropical year has been adopted for general use and the calendar has been adjusted to fit it. By this means the vernal and autumnal equinoxes are caused to recur respectively, on March 21st and Sept. 22nd each year—except for the variation of one day (forward) due to the leap year compensation,—and the months of the particular seasons thus do not change.

The Calendar

Julius Caesar found the Roman calendar in hopeless confusion. He sought the advice of Sosigenes, an Alexandrian astronomer, and, in accordance with his suggestion, Caesar, in 45 B.C., established what came to be known as the "Julian" calendar. By this arrangement, the year consisted of 365¼ days, the fraction to be adjusted by adding one day to every fourth year. Also, the year was now to start on January 1st, not in March as previously, and all days were to be numbered consecutively from a date in the far-distant past,—noon on January 1st, 4713 B.C. This calendar is still in use: January 1st, 1938, will be the 2,428,900th day since the beginning of the Julian Period.

At the time of the Council of Nice, A.D. 325, the vernal equinox occurred on March 21st. By the year A.D.

1582, however, it had advanced to March 11th, under the Julian calendar. Pope Gregory XIII, therefore, on the advice of the astronomer, Clavius, corrected the calendar in that year by issuing an edict that the day following October 4th was to be known as October 15th, thus skipping the ten days, and he made further adjustment through a new rule by which those centurial years that are not multiples of 400 would not be leap years, e.g., 1700, 1800 and 1900 would not have the extra day but 2,000 will have 366 days as in the Julian arrangement. He thus brought back the vernal equinox to March 21st and made refinements in the system to adjust the calendar more closely to the tropical year.

Britain did not make these changes until the year A.D. 1752, by which time a correction of eleven days was necessary, so the day following September 2nd was designated September 14th, and the year had only 355 days, instead of 366.

The accuracy with which these calendars fit the tropical year is of particular interest. The Julian year is too long by 11 minutes, 14 seconds,—slightly more than three days in 400 years. The Gregorian year is a closer approximation but still too long by 26 seconds, requiring a correction of one day, to be skipped, every 3323 years.

At the present time there is a difference of thirteen days between the Julian and Gregorian calendars,—i.e., the ten days difference which existed in 1582 plus three more days because the years 1700, 1800 and 1900 were leap years in the former but not in the latter calendar.

Fig. 2.—The stars moving in circular paths around the north celestial pole, —an apparent motion which is due to the earth's rotation on its axis. The north star, having the short very bright trail, is about one degree from the pole.

The Earth's Temperatures

At present, when it is winter in northern latitudes, the earth has approached nearest to the sun, which undoubtedly tends to moderate the cold weather,—and at the same time gives hotter summers in the south latitudes. In years to come,—about 65,000 years hence,—winters in northern latitudes will find the earth at aphelion, its greatest distance from the sun, with about 6 percent less heat received than at present, and, consequently, much colder winters and hotter summers than we now have. In all probability it was some such phenomenon as this that brought about the ice age,—the northern glacial period,—which appears not possible to occur just now.

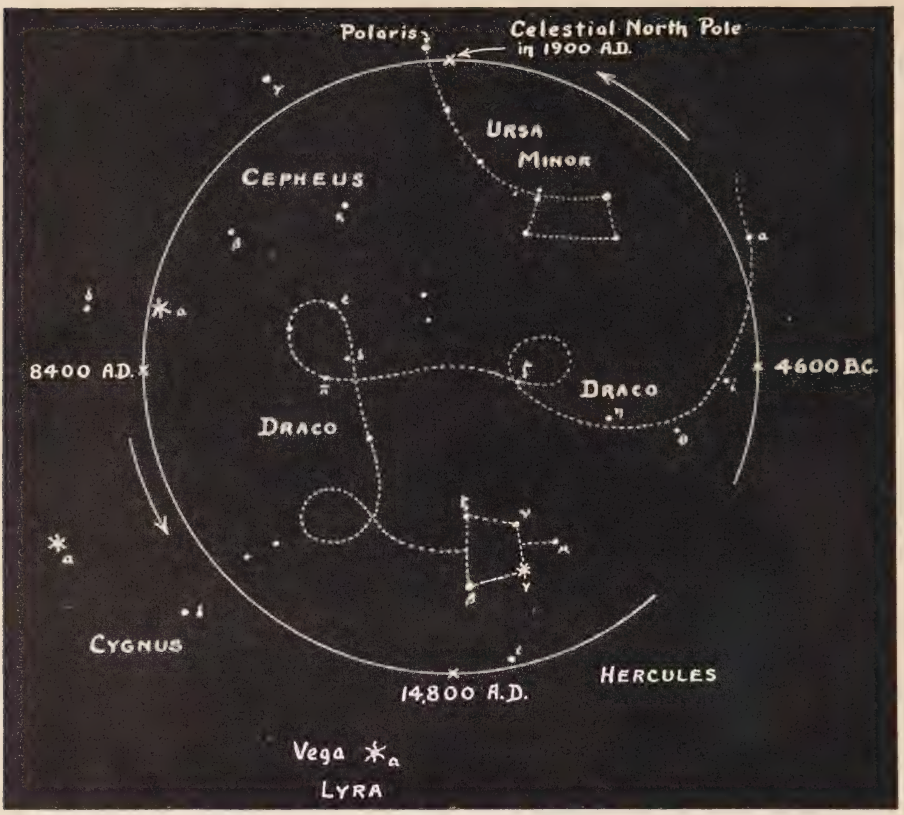


Fig. 3—The path of the north celestial pole through a complete cycle of motion,—25,800 years.

The Changes in the Stars

The North Star, Polaris, is not north,—not exactly. It is about one degree away from that position,—the celestial north pole of the sky,—and in the year A.D. 2095 will be less than one half degree from it. It is not the stars that are changing positions at this rate, however; the phenomenon is due to the changing direction of the earth's axis, the movement which produces the precession of the equinoxes.

In the year 2000 B.C., the brightest star in the constellation Draco was about four degrees from the celestial pole and our present north star was then 25 degrees away from it. In the year A.D. 13055, the bright star, Vega, in the constellation Lyra, will be the "north star" but will be about 5 degrees from the pole. When the earth's axis has made a complete precession,—by about A.D. 27700,—our familiar north star, Polaris, will be back again, near to its present position.

While Vega remains the north star, many southern constellations which are not now seen in northern latitudes, will rise regularly,—the South-

ern Cross, for instance, will be seen in Toronto,—and also some present northern constellations will rise in southern latitudes.

The changes are so very slow, however, that they can hardly be realized but from accurate measurements it is determined that everything will be back "in its place" again after 25,800 years.—*F.K.D.*

CORRECTION

In the November issue, page 365, the second last paragraph should read:—

It is very remarkable that all of the larger planets,—Jupiter, Saturn, Uranus and Neptune,—rotate in about half the period of the smaller planets —the earth and Mars.

D. R. Brockbank, Paris

On Sunday, November 28, death came to David Robson Brockbank, former Superintendent of the Public Utilities Commission of Paris, Ont., and a well-known and highly respected citizen of that town.

Thirty-nine years ago, in December, 1898, Mr. Brockbank joined the staff of the Waterworks Department of the town of Paris, where he advanced to the post of Superintendent. Later he was also made Superintendent of the Paris electric utility and when the Paris Public Utilities Commission was formed, controlling both water and electric departments, was retained as Superintendent. In 1933 on completion of thirty-five years of service, Mr. Brockbank was presented with an illuminated address by the Public Utilities Commission. He retired in November, 1935, and since then has acted in an advisory capacity at the Lion's Park, his ability as a florist and landscape gardener having a great deal to do with beautifying the grounds, and making the park a safe and healthful place for the children to play. He was active in any movement tending to keep Paris in the forefront, and where children were concerned was a special friend.

Mrs. Brockbank survives him, as also one son, two brothers and two sisters.

Convention Programmes

THE Annual Meeting of the Ontario Municipal Electric Association will be held concurrently with the winter convention of the Association of Municipal Electrical Utilities at the Royal York Hotel, Toronto, on Tuesday and Wednesday, February 8th and 9th, 1938. The programmes are so arranged that there will be no joint sessions, the two associations meeting together only for the convention luncheons and dinner.

* * * *

Accident Prevention Meeting

Under the joint auspices of the Committee on Accident Prevention and Health Promotion of the A.M.E.U. and the Electrical Employers' Association of Ontario, a dinner meeting will be held at 6.00 p.m. on Monday, February 7th. This meeting will discuss the various accidents that have occurred during the past year, the discussion being given by the managers of the utilities, and as a round table will discuss ways and means of preventing accidents in the future. Opportunity will also be given for the full discussion of a utility in Ontario under the Workmen's Compensation Act.

* * * *

O. M. E. A.

The order of business of the O.M.E.A. Annual Meeting will be somewhat as follows:

Monday—February 7th.

Evening.

8.00 o'clock—Executive Meeting.

Tuesday—February 8th.

Morning.

Registration.

10 o'clock—General Meeting.

Minutes.

President's Address.

Secretary's and Executive Report.

Treasurer's Report.

Afternoon.

12.30 o'clock—Convention Luncheon with A.M.E.U.

Address.

2.30 o'clock—General Meeting.

Credential Committee's Report.

Finance Committee's Report.

Business arising out of Reports.

Report of Resolutions Committee.

Evening.

6.30 o'clock—Convention Dinner with A.M.E.U.

Address.

Wednesday—February 9th.

Morning.

9.30 o'clock—General Meeting.

Election of Officers.

Election of District Directors.

Report of Convention Committee.

Unfinished Business.

New Business.

General Discussion.

Afternoon.

12.30 o'clock—Convention Luncheon with A.M.E.U. and the Electric Club of Toronto.

Address.

2.30 o'clock—Meeting of District Associations to suggest work programme for 1938.

A. M. E. U.

The programme of the A.M.E.U. convention has been tentatively arranged as follows:—

Tuesday—February 8th.

Morning.

Registration.

10.30 o'clock—Convention Session.

Reports of Committees.

Afternoon.

12.30 o'clock—Convention Luncheon with O.M.E.A.

Address.

2.30 o'clock—Convention Session.

Paper—"Control Systems for Domestic Loads"—By W. B. Buchanan, Testing Engineer, H.E.P.C. Laboratories.

Paper—"Municipal Hydro-Electric Pension and Insurance Plan"—By Fred A. Robertson, Acting Secretary and Treasurer, Municipal Pension and Insurance Committee and A. S. Robertson, Director of Associated Services, Confederation Life Association.

Evening.

6.30 o'clock—Convention Dinner with O.M.E.A.

Address.

Wednesday—February 9th.

Morning.

8.30 o'clock—Breakfast Meeting.

The Committee on Accounting and Office Administration will conduct a conference on Accounting.

9.30 o'clock—Convention Session.

Discussion—Answers to questionnaire on "General Operating Problems."

Paper—"Hydro-Bell Agreement for Joint Use of Poles"—By S. K. Cheney, Assistant Engineer, Distribution Section, Electrical Engineering Department, H.E.P.C. of Ontario.

Paper—"Insulated Cables for Power Distribution and Street Lighting Circuits"—By O. W. Titus, Chief Electrical Engineer, Canada Wire and Cable Company, Toronto.

This session will adjourn for lunch when the time comes and the unfinished work will be taken up at the afternoon session.

Afternoon.

12.30 o'clock—Convention Luncheon with O.M.E.A. and the Electric Club of Toronto.

Address.

2.30 o'clock—Convention Session.

Continuation of the morning session and completion of the items outlined for it.

* * * *

Election Ballot

The election ballot for officers of the Association of Municipal Electrical Utilities for the year 1938 will show the following as candidates:—

PRESIDENT—R. S. Reynolds, Chatham. Acclamation.

VICE-PRESIDENT—George E. Chase, Bowmanville, and V. A. McKillop, London.

SECRETARY — S. R. A. Clement, H.E.P.C. of Ontario, Toronto. Acclamation.

TREASURER—B. Faichney, H.E.P.C. of Ontario, Toronto, and S. E. Preston, H.E.P.C. of Ontario, Toronto.

DIRECTORS *(from the membership at large)*—A. B. Manson, Stratford; J. R. McLinden, Owen Sound; O. H. Scott, Belleville; O. C. Thal, Kitchener; C. A.

Walters, Napanee; and P. B. Yates, St. Catharines.

DISTRICT DIRECTORS—

NIAGARA DISTRICT: A. W. Bradt, Hamilton, and T. R. C. Flint, Toronto.

CENTRAL DISTRICT: W. G. Henderson, Cobourg and H. L. Pringle, Whitby.

GEORGIAN BAY DISTRICT: W. M. Salter, Barrie. Acclamation.

EASTERN DISTRICT: S. W. Canniff, Ottawa and R. J. Smith, Perth.

NORTHERN DISTRICT: C. J. Moors, Fort William, Acclamation.

The ballots will be distributed during the morning of the first day of the convention.

Immediately after the opening of the afternoon session on Tuesday, the 8th, the ballot will be closed and the results of the elections will be announced before that session closes.

* * * *

O.H.E. Club Dance

The Ontario Hydro-Electric Club will hold its annual dance at the Royal York Hotel on the evening of Wednesday, February 9th, and extends a hearty invitation to all O.M.E.A. and A.M.E.U. delegates and their friends to attend.

Rat Rapids Development, Albany River.

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